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# MICROCOMPUTING<sup>T.M.</sup>

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## Great Expectations

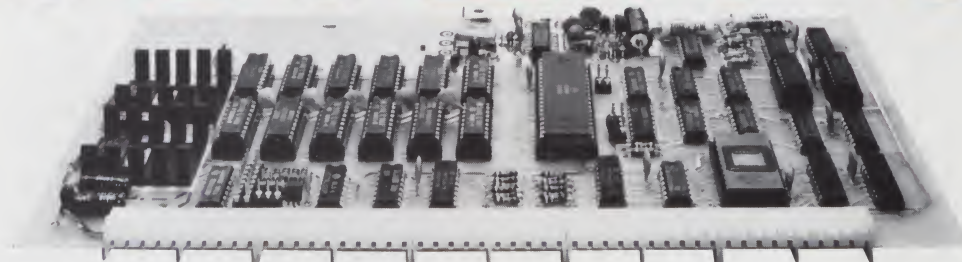
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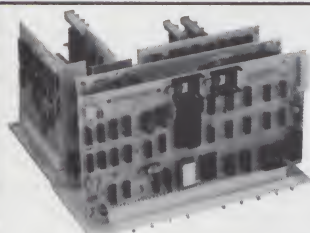
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## This month: Microcomputers: Toys or Tools?

Much has been written (in publications such as *Time*, *Business Week* and *The Wall Street Journal*) about the significance of the entry of IBM and Xerox into the realm of microcomputing. These giants have determined that microcomputing has reached a level and rate of growth sufficient to find it profitable for them to enter the market. How will these big-name microcomputers affect sales of established microcomputer manufacturers like Apple and Radio Shack? Regardless of immediate effects, the long-term result should be a boon to the entire industry. This, in fact, is the real question: Will the expectations of the industry come closer to realization because IBM and Xerox are now a part of the industry?

The entry of major computer companies into personal computing should definitely have a legitimatizing effect on the industry. The general public and, more importantly, the overall "computer community" will have to take a more serious look at what we are doing in the microcomputing field, which is rapidly becoming a major industry.

It has been disconcerting to meet recent computer science graduates who have never worked with microcomputers. Some are completely unaware that a microcomputer industry exists. More unsettling is the view of many in the computer industry, manufacturers and consultants, that the micro or personal computer is a toy that can do nothing serious.

The new major micro manufacturers have not introduced industry-revolutionizing products from a technical point of view (though IBM's use of the 16-bit 8088 processor with an eight-bit data bus results in a machine that should bridge the gap between older eight-bit and newer 16-bit microcomputers). But will they change the industry in other ways? We'll keep you updated on new software and peripherals for their computers.—**The Editors**

## This month's cover:

Photo by Lighthearted Studio. Special thanks to Computerland of Nashua, NH, for their assistance in preparing this month's cover.

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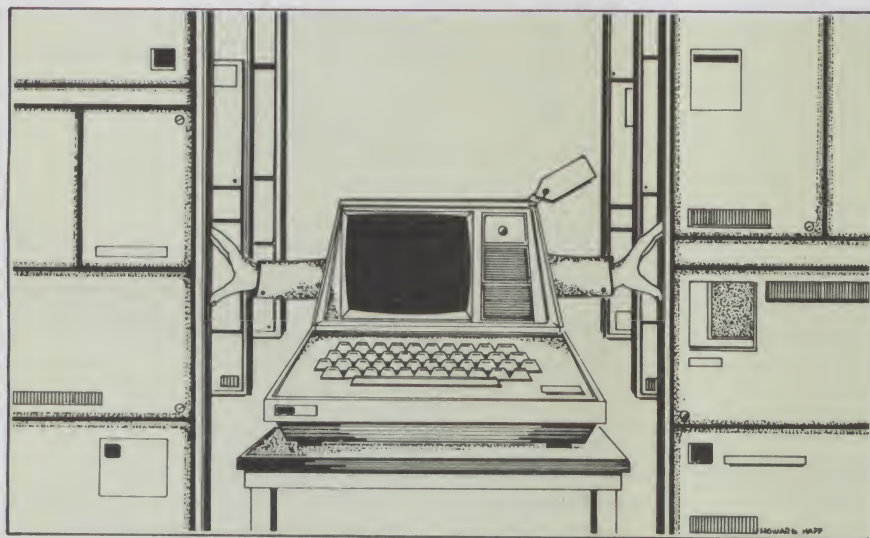


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# Devastating Truth About Minis



## Mini Squeeze

With some amusement I read the article in the Sept. 28 *Business Week* explaining that the minicomputer pioneering firms are being hit hard by the growing market for microcomputers. A significant number of people have been buying \$5000 word processors rather than the \$15,000 models (which do precious little more).

These are the same folks who have been walking through the microcomputer section of the NCC exhibits for the last three years sneering at the toys. They are the same aloof folks who have not bothered to read this magazine and its editorials warning that just this would be happening . . . and soon.

I predict that there are going to be a lot more traumatized minicomputer firms and their attendant support software and peripheral firms as the word spreads about what our microcomputers can do . . . and how inexpensively.

Several factors are ganging up on the mini people which can't help but force many of them out of business. One of the

more decisive of these is the general media's growing interest in micros, which is bringing the word of this low-cost computing power to businessmen. Aiding that are publications such as our new *Desktop Computing* which tell the businessman in plain language what these small computers are doing for other firms . . . and by extension what they can do for him.

Another important factor is the normal human tendency to try to keep the world from changing. Most firms go along spending 100 percent of their efforts trying to solve present time problems with the result that when a major change in technology comes along it can upset everything. With emphasis on developing some immediately needed software or an accessory, and on getting the sales department to get a slightly larger share of the market, few firms have anyone with the time to notice an approaching catastrophe.

Add to that the wonderful successes most of the mini firms have had, which have focused their attention on production and incremental changes in the

product. The problems have involved keeping up with the demand and making deliveries, not coping with a competitor coming in from left field.

Minicomputer (and maxi) firms have been blinded, too, by the power of their equipment. They have not stopped to look carefully at the micro growth and noticed that these seemingly insignificant toys have been growing in their ability to tackle real work. Micro manufacturers have had to endure the overbearing attitude of the mini firm people at NCC ever since they started trying to show their systems. They would come by in small groups, making snickering remarks to each other and then go back to the main exhibits where they were comfortable with "real" computers.

## The Mini Role

If the minicomputer firms are going to weather the next few years, they are going to have to get their people together, look closely at microcomputers and figure what segment of the market their systems fill which micros can't.

There is both good news and bad news for the minis. The bad news is that they can expect micros to be used for most of the smaller firms around the world . . . and thus there is a far larger overall market for micros than for minis. They can also expect to lose most of the desktop market, even in the larger firms, as businessmen opt for a combination computer/terminal rather than just a terminal.

The good news is that micros will bring computing to everyone, and the need for the more powerful mini systems will be better recognized. Larger firms will find that micros are too slow for their needs and move to larger and faster systems. Businessmen will be able to do most of their work on a micro, but will need a host mini for some specialized applications such as number crunching, large databases, networking and so on.

Until the mini people take off their blinders and put their systems into perspective from the viewpoint of the busi-





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nessman, they are sailing in dangerous waters. Their salesmen are going to have a tougher and tougher time pulling a con job on businessmen. The firms are going to have to have systems which really do what they claim.

### Another Wall Crumbleth

A fair segment of the computer industry are the DP managers and systems analysts. These people are going to have to make some major readjustments to their way of life if they are going to survive in anything but decreasing numbers. One of the tools of their business in the past (and present) is the ignorance of the average businessman—and executive—about computers. This mystique has been kept intact through the use of a foreign language, used in many cases more as a smoke screen than for real communications. Magazines such as *Desktop Computing* will soon blow this cover, exposing DP managers to some searching questions which they will have to start trying to answer in plain English.

Indeed, the data processing professional who is not thoroughly familiar with microcomputers is already out of date. Any firm which hires someone to manage its data processing, or information management—or any of the other proliferating buzzword phrases for saying essentially the same thing—and does not make sure that the person is also an expert on microcomputers is asking for huge losses of its computer investments.

Now, I haven't done a specific study of the microcomputer literacy of DP people, but I do read all of the same magazines and papers they do and I'm reasonably sure that they, as a group, don't know beans about micros. *Computerworld* is a large and successful publication, but the attitude I've seen in it has been the same one I've seen at NCC—arrogant amusement with these insignificant upstarts. This can't help but poison the water for the professionals who read it every week.

The other publications read by the DP professionals have carried on in the same vein, helping them maintain their ignorance of microcomputers and their capabilities. It feeds on itself, with the writers and editors of these journals all being a part of the maxi and mini world and thus conditioned to ignore the new smaller systems.

### School Debacle Too

Most of the colleges which have been teaching computing have built up systems based upon maxi or minicomputers, and the departments which have run these systems have been as biased against micros as everyone else in the computer field. The result has been a twisted perspective on the part of the students, who merely follow along with the same lack of respect for small (toy) computers.

Indeed, I've talked with many of the

college DP people and found the prejudice against micros impenetrable. Even those who happen to get hired by a microcomputer publication have not been able to get over this bias.

Last year I talked with several colleges about setting up microcomputer courses. I found myself up against entrenched DP professionals who felt this would really be a waste of time for the students. Why should they bother to learn about computers with such limited capabilities? One of these professionals had put together an Altair computer, so he was even more convinced of his position as the owner of a microcomputer.

This attitude is beginning to change, but all too slowly for the good of the computing industry. We need people who have perspective on the place of microcomputers and minicomputers rather than bigotry. The firm hiring a new DP person has every right to expect an honest evaluation of its DP needs which will give it the most computing for the money spent. Today the larger firm has two and three quarters strikes against it in this respect.

### The Microcomputing Reader

The totals for the reader surveys in the May and June issues of this magazine are in. Not bad! I'll try to get a detailed report available for advertisers and prospective advertisers, and just cover the highlights here.

Starting with the age of our readers, we had the largest group in the 25–35 year bracket, with the average age of the reader being 35. From an advertising point of view this is just about ideal because this is the group with the most money to spend. These people are right in the middle of their most productive years.

The annual income—averaging \$29,250—surprised me. I was also amazed to see that 9.8 percent of the readers are making over \$50,000 a year. Seventy-five percent are making over \$20,000 a year. That helps to explain the remarkable success in selling stories we hear from advertisers.

Advertisers will be interested to learn that over two-thirds of our readers claim that they either make the purchasing decisions or have influence in these decisions when it comes to purchasing computer equipment for their company. How much will the average business be spending for computing power in the next year? If we make a wild guess and estimate an average investment of only \$5000 per business—with our survey showing 220,000 readers per issue—this would net out at about \$61 million per month being purchased just via our readers.

If these 147,400 *Microcomputing* readers don't see ads for a system, how can

you expect them to think about it when it is recommendation time? That's about 12,000 microcomputer systems a month which are bought for business as a result of our readers. That doesn't include the systems they are buying for their own use.

One statistic which surprised me was that 22.9 percent of our readers have not yet bought a computer. There's a market for another 50,000 computers right off the bat. If we estimate the average investment at \$2550 (which was the average claimed by our readers), that would point to a ripe market of \$127 million in sales. That's only another \$10 million a month if we figure to get all of them during the next year. But \$10 million here and \$10 million there . . . and soon you're beginning to talk about real money.

*Kilobaud Microcomputing* has been viewed by many ad managers as being hobby-oriented, so I was interested to see that about 60 percent of the readers are using their systems for other than personal computing applications. We did start out aimed largely at the hobbyists, which is what the market was in 1977. When I saw that the new breed of hobbyist was different from the old one, I changed the orientation of the magazine to satisfy the needs of this new group. I'm not sure that the word "hobbyist" is applicable, but we do need some definition for the person who has bought a computer and is now deeply involved in learning about it. That is the aim of *Microcomputing* magazine today.

A survey of the computer systems in use by the readers shows some substantial changes since our survey a year ago. Things are changing . . . and rapidly. For one thing, the percentage of Apple owners is catching up with the TRS-80 owners. Some of this obviously has to do with TRS owners changing their allegiance to *80 Microcomputing*. Indeed, we were a bit worried that the loss of TRS readers to 80 might hurt the circulation of *KM*. It did slow the growth down a bit, but that's all.

From the latest survey it looks as if we have something over 400,000 different readers for the two magazines. When you consider that *Byte* has about that and charges more for ads than our two magazines combined, there are some advertising bargains available for the shrewd buyer.

Comfortably in third place now is Heath, with almost double the percentage of the PET, which has been dropping steeply. That's a pity, but with virtually no advertising and a discouraged bunch of owners as a result, perhaps that was to be expected. In fourth place, coming up fast, is OSI. Over 12,000 of our readers have the OSI systems so far.

Well, that's enough of that. I'll try to have the dry details in our sister publication, *Microcomputing Industry*, a smaller magazine sent to the industry every month.



## The New Microcomputing

Well, that's what manufacturers say when they make changes in their product. Since we're always making small changes in *Microcomputing*, perhaps we should put "new" on the cover every month. With a growing number of publications covering the microcomputer field, it is obviously important for us to keep in mind what you, the readers, want in a magazine. I've been trying to keep *Microcomputing* aimed at your needs and make it worth your while to spend the time needed to read it... and worth the money to buy it.

With well over a dozen magazines in the field, even if you could afford to subscribe to all of them you wouldn't have the time to read 'em. There's just too much information. So, if we are going to continue to be worth your time and money we have to provide what you need—the articles and programs which you will find of personal benefit.

I get every magazine in the field—and I try the best I can to read them—so I know what they're doing and what position they have in the field. I've tried to figure out what areas should be covered by my four computer publications so I can help the editorial staffs select articles which are consistent with what you need.

Starting with our newest magazine, *Desktop Computing*, we have a publication aimed at the businessman and educator to tell them in plain English what microcomputers are able to do... and offer avuncular advice on what goes into the selection and purchase of a system. This magazine also explains in plain language what all those peripherals and programs do for you.

Then there is *80 Microcomputing*, which is aimed at the owner of a TRS-80 computer. It offers extended documentation, evaluations of accessories and programs which are commercially available, plus a very generous supply of the best programs we can get... with both full listings in the magazine plus an available cassette dump of these listings. *80* is, I think, one of the most successful technical publications of all time. In less than two years it has gone to over 100,000 circulation and over 400 pages. Advertisers tell us that they've never seen a magazine that comes even close in selling power, which explains the steady increase in advertising and magazine size. It is not, like *Byte*, top-heavy with ads, running about 40 percent or so to their 60-70 percent and usually running about three times as many articles.

*Microcomputing (Kilobaud)* is aimed at the relative newcomer to computers, the person who has a computer and wants to learn as much as possible about using it. The documentation available from most system manufacturers is scanty, so if you are going to get much out of your investment in a computer you

want to get all the information you can about using your system. You want to know what is available for it in accessories and in programs. And, considering the cost of packaged software, *Microcomputing* has a wealth of usable programs.

The more advanced computer owner, computer scientist and data processing professional may find my first magazine, *Byte*, a good bet, despite the small amount of editorial matter in each issue (15-20 percent). It's now published by McGraw-Hill.

In addition to my three main magazines, I also publish a smaller one for the industry called, imaginatively enough, *Microcomputing Industry*. This is sent to every known store selling computers, to all manufacturers of hardware for microcomputers and to all software firms. In

this magazine I tell dealers how to sell and manufacturers how to manufacture, and discuss shows, methods of product distribution, the inside skinny on advertising and so on.

There are specialized publications for the Apple, Heath, Sinclair and other systems. These smaller magazines have some serious problems which are difficult to overcome. It is very hard for them to get first-rate material because they can't possibly meet the article payments authors get from the larger-circulation magazines. The same goes for the programs they publish. People who write programs are, like you and me, anxious to get all they can out of the work they have put in, so they look first for a software publisher who might be able to bring them hundreds or even thousands

## SORCERER SOFTWARE

### SUPER ASTEROIDS by Apollo

'A new era in real time graphic arcade games'.

Never has there been such a captivating and superbly written arcade game for the Sorcerer. Styled after the well known and very popular ASTEROID DELUXE arcade game, SUPER ASTEROIDS is destined to become the most popular piece of demonstration software used by dealers and users alike. Perhaps it is the outstanding use of fine line graphics or the silky smooth movement. Maybe it is the breathtaking speed, dazzling explosions, gripping sound effects or simply the challenge of avoiding those fire balls from that persistent flying saucer that insidiously follows you across the screen. Whatever it is, we warn you NOT to purchase this game for fear that you may join the ranks of hundreds of other ASTEROID Addicts who, square and bleary eyed at 3 am, just MUST have ONE more go at trying to beat that High Score.

The object is to guide a small space ship across the screen avoiding but shooting asteroids as they glide past. When an asteroid is hit, it will break up into many smaller pieces. By repeatedly hitting the pieces they will soon disintegrate and disappear. If you crash your ship into an asteroid it will break into pieces and splinter across the screen in a shower of sparks! However, if you manage to stay in one piece, chances are you'll soon be pursued by a flying saucer that shoots balls of fire! Best that you treat him with care, else you may make his friends VERY aggressive.

Apollo has used a novel but ingenious method of continually reprogramming graphics characters and has obtained stunning results! All movement is done pixel by pixel but without speed loss. Numbers of asteroids, directions, speeds and such like are all totally unpredictable. If you can show us a piece of software that has finer, smoother and faster graphics than SUPER ASTEROIDS, we guarantee to refund your money in full!

Cassette \$29.95

### ZAP80 'Secret Code

Disassembler'. by Ian Robinson

This is far from your average run of the mill disassembler! Other than being a mere 4K long, able to disassemble at the speed of light and packed with options, ZAP80 will display before your very eyes all those unknown instructions ZILOG never talk about! Ian has been doing extensive research into the actions of the Z80 processor when confronted with the 700 or so undocumented (and so called 'illegal') code sequences. Over 100 of these are VERY useful! Did you know you have extra 8 bit registers and a complete set of instructions to manipulate them? Did you know about extra rotate instructions?

ZAP80 will disassemble ANY code sequence. Nothing is illegal! It will allow you to program with codes that no other disassembler can decipher! Think about that....

ZAP80 comes with documentation and explanation of all new mnemonics used. Three versions are supplied that reside in low, mid and high memory. Options include ASCII output, screen pause and customised printer control.

Whether you are a serious programmer, a beginner or simply curious, ZAP80 is a piece of software you must have. Come and play a REAL adventure game!

Cassette \$24.95

### HOW TO ORDER:

ALL PRICES ARE IN AUSTRALIAN DOLLARS. One Australian dollar equals 1.16 American and 1.4 Canadian. All programs come standard on cassette but some may be requested on either Micropolis II Quad density or VISTA 5 1/4" diskettes for an additional cost of \$5.00 per diskette. Note that more than one program will fit on a diskette. Programs available or diskette include CIRCUS, GALAXIANS, GROTHNIK WARS and ZAP80. \$2 discount if this form is used. (Photostat will suffice).

PROGRAM	PRICE
Postage within Australia is \$1 for initial item and 50c for each additional. Outside Australia is \$2 and 50c.	
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TOTAL	

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We are a dynamic Western Australian enterprise whose sole aim is to bring you the best in Sorcerer software.

A catalogue such as this is produced regularly and sent to approximately 2000 interested Sorcerer users in all parts of the world. Let us know if you wish to be included on our mailing list.



of dollars for their program. Next they look for the larger magazines. Here *Microcomputing* has a decided advantage, since programs submitted for it are also considered for publication by Instant Software, with all the royalties that can bring. In general then, once you are past *Microcomputing*, *80 Microcomputing*, *Desktop Computing* and *Byte*, you are likely to be reading material that has been rejected by the first teams.

Speaking of Instant Software, our program-publishing division is now rounding out its third year in business. If you are a programmer you should keep publishing houses such as this in mind. The market for packaged software is growing rapidly, with predicted sales going into the billions within a few years. With none of the systems manufacturers doing very much in the way of developing software, this represents a great opportunity for the home programmer to get a piece of the action in this amazing new field.

There is one other important benefit to *Microcomputing* as compared to, say, *Byte*. They have gone to around 200,000 circulation, which means that the ad rates are impossible for smaller firms, the ones most likely to give you the newest gadgets and best bargains. We have aimed at 100,000 circulation (with about half the advertising rates) so you will have better ads from which to choose.

Perhaps, if you've picked up *Byte*, you've noticed the difference in the type of advertising.

Between this publication and *80*, we, too, have 200,000 circulation, only it is spread out in two complementary magazines. Advertisers wanting to reach everyone can advertise in both of our magazines, reaching as large a readership as in *Byte*...only perhaps less weighted with data processing professionals. Advertisers not selling TRS-oriented products can reach their prospective customers at half the cost...while TRS products can use *80*, again at less than half the cost of *Byte*. Perhaps this is why *80* has increased in ad pages this year far more than *Byte*...and last year also.

Our editors enjoy the competition with *Byte* and the other micro magazines. Remember that many of us here started and edited *Byte* in its early days. Alas, as it mentioned in the *Wall Street Journal*, I and the others here are a cross they have to bear. Why did I think of Robert Vesco and his problems when I read that?

At any rate, *Microcomputing* is edited to bring you the information you need as a microcomputer owner. It's aimed at the relative newcomer rather than the scientist or hardened professional. We have a lot of hobbyists reading us...and businessmen who want to better understand

and use their systems. We do cover all computer systems, but since *80* goes into the TRS in depth, we do not give that system equal time here. If you have a TRS you really need to keep in touch via both magazines.

## Program Theft

One of our Instant Software dealers in New York complained in frustration the other day that he really needs only one copy of each new program. Once that is sold, he claims, within days it is all over town, being given away by a chain of stores which sell computers.

It's difficult to tell whether he is right about this or whether he may be overreacting to one or two such cases. And if it is happening as he says, the question is whether this is something cooked up by a local group of these stores or whether it is a policy of the whole chain.

Another chap, who was involved with a major computer summer camp project put on by a well-known college in conjunction with a major computer manufacturer, claimed that the students were given copies of Instant Software programs by the instructors as part of the course.

Then we have the case of a recently-returned Instant Software program which was not made by Instant Software. It was a forgery.

In case there is even the slightest question in anyone's mind about this, all Instant Software programs are copyrighted. They are protected by law from being copied for sale or even for a gift. It is illegal to make a copy for anyone other than yourself.

The reason for this should be clear to anyone involved with computers. You know as well as I how much work is involved in writing a program. You probably have only a dim concept of the work and expense which goes into distributing that program, but the economics of this distribution are such that the programmer ends up with a bit over 10 percent of the retail price of the program. Believe me, if there was any way to make that higher we would. That's appreciably more than book authors generally get.

If programs are copied and exchanged, this is a loss to the programmer and to the program publisher. Each time there is a theft like this there is that much less chance of more good programs being written.

Since many people are able to rationalize away buying stolen property, whether it is a computer, a typewriter, a car or a program, obviously just depending on honesty for protection is a weak plan. In the case of Instant Software I have offered a \$10,000 reward for information which enables us to get a conviction of someone copying our copyrighted programs. I am serious about it, even

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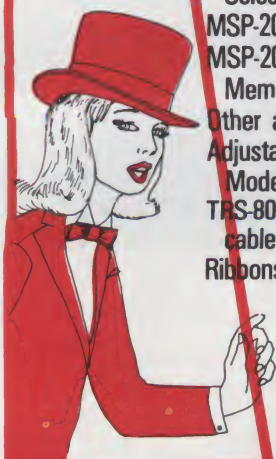
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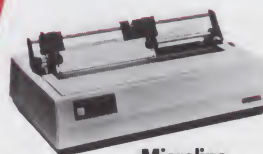
**Other available options:**

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 Model 54100201 .....\$ 50.00  
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 cable to printer .....\$ 35.00  
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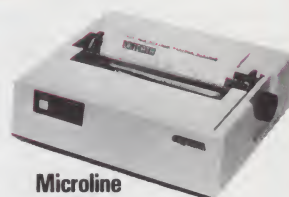


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though the *Whole Earth* people have called me a fascist for this.

I figured that it would take something substantial to break down the normal reluctance to be involved, even when a crime is being perpetrated. \$10,000 can do a lot of things for you... such as an all-expense paid trip around the world for two... or a very big microcomputer system. The main purpose of the large reward was to discourage stores from giving away copies of Instant Software programs. Also schools, clubs and so on.

These thefts are not penny-ante, by the way. The New York caper has been estimated to have cost Instant Software in the neighborhood of \$750,000 in sales so far, while that summer camp theft has been estimated to be over \$500,000. You may be sure that should we get someone to come forth and testify against a store, a manufacturer, a school or a club that the damage claims will be substantial.

Speaking of clubs, if you are a member of an unincorporated computer club and that club is engaged in swapping programs, you should know that you can be sued as a member of the club, even if you had nothing to do with the program theft. If a software publisher sues a club, they will, in all probability, go after every member of the club... and particularly be on the lookout for any members with assets which will make them more sueable than the others. Incorporated clubs are a bit safer, but you are asking for it if you belong to any club which engages in program theft.

I am looking for anyone who will come forth and bring evidence of the copying of any Instant Software package. Copyright infringement cases are not difficult to prove and there is a long line of court cases where large awards have been given. Indeed, I know of some map pub-

lishers who make hundreds of thousands of dollars in such awards every year... mostly from small firms and clubs who have innocently used a map in their advertising or promotions, but not reckoned with the copyright problems. The penalties can be stiff... all out of proportion to the crime.

Before I succumb to pressures from the Instant Software people to encode programs so they can't be listed... or even go to a system which will require a hardware gadget as part of the decoding... I think it's worth a big try at getting the cooperation of *Microcomputing* readers.

Please keep your eyes peeled for any program theft. If you run into it I would appreciate a letter. If you are chicken and are afraid to openly blow the whistle, either don't sign the letter or ask for confidentiality. I would much prefer you go for the \$10,000 and work out a system for getting a program copy which will stand up in court when we go after the thieves. You may want to use a hidden tape recorder (I always have a microrecorder with me), a friend with a small camera... or the cooperation of a friend in testifying.

The very least we can do at the present is make it quite clear that when anyone gives or gets a program from a friend, in a store, at a club, in school, etc., that both parties are well aware that this is a theft... that the penalties are severe and not a casual matter. You may be sure that no one is going to enter a suit for any small amounts... they will be big, even against individuals such as school children. Just the legal costs alone could put a good percentage of the computer stores out of business.

Should you find yourself tempted to run off a copy of an Instant Software program for someone, be awfully careful that he is not entrapping you for that trip

around the world for two. He can always find new friends, but how often will he get a trip like that?

### Anticopy Programs

There is a need for a good deal more work on both the simple hardware solution to the copying problem... and a possible software solution. Perhaps it is getting time to just forget about trying to work with honest people and prepare products to thwart the crooks. Yes, this will make it very difficult to ever make any changes in the program... or to use it as a teaching tool to learn more about programming. It will also prevent simple repairs in case you make a mistake in loading. I don't like that any better than you... but *something* has to be done. What do you suggest? □

### Tax Deductible

Treasury regulation 1.162-5 permits an income tax deduction for educational expenses undertaken to maintain or improve skills required in one's employment or business.

Since computer literacy is a skill required in virtually any business these days, a subscription to *Kilobaud Microcomputing* or even the purchase of a new computer would be tax deductible in most instances.

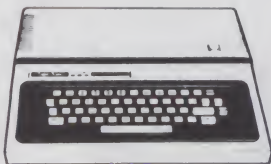
## MICRO QUIZ

### Digital Electronics

Draw the most simplified circuit (the one that minimizes the number of gates used) that takes one-bit numbers as inputs and outputs the least significant bit of their sum.

Answer on page 238.

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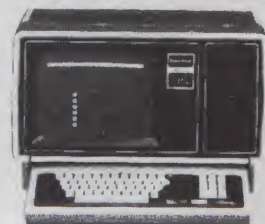


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# FORTH

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SCREEN EDITOR

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An absolute must for the serious FORTH programmer...

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Current tab over value and CP location displayed at all times.

Deupdate command included along with other utilities.

Works very well with memory mapped video.

Maintains its own 64 byte buffer that never changes location. Any text transferred to it via CTRL-T will remain until system shut-down or another CTRL-T transfer.



Message displayed when iNsert mode is toggled on via CTRL-N.

A special formatted list routine included for printer output.

CP is never allowed outside of the FORTH screen boundary.

Less than two lines of code need to be changed to work on most any terminal. (Clear screen code and the XY cursor addressing.)

Screen format for the standard CRT version.

**List of commands:** These commands are for the TeleVideo 912, but are very easily modified to match the character set or special functions keys on any terminal.

- DEL Delete — Delete character to left and move CP left one position.
- CTRL-L Right arrow → — CP advances one position to right.
- CTRL-H Left arrow ← — CP advances one position to left.
- CTRL-G Get character — Character at CP location is erased when all text on line to right is moved left one position. The end of line character location is blanked out.
- CTRL-I Tab over to next tab location — The tab over count is stored as a variable and can be changed to any number between 0 and 63. CP will advance to next location each time command is given.
- CTRL-J Down arrow — CP moves down one line and maintains same column position.
- CTRL-K Up arrow — CP moves up one line and maintains same column position.
- CTRL-E Erase line — Line occupied by CP will be completely erased.
- CTRL-S Spread open — All lines below and including CP line move down one line. . .last line is lost.
- CTRL-T Transfer — Transfer the CP line to the editor buffer. . .the editor buffer contents will be overwritten.
- CTRL-R Read — Read a copy of the editor buffer into the line occupied by CP. . .editor buffer contents remain unchanged.
- CTRL-D Delete and close — All lines below CP move up one line and last line is erased to all spaces. . .original line is overwritten.
- CTRL-C Clear — All lines below and including line occupied by CP are erased to all spaces. . .total screen is erased if CP is on first line.
- CTRL-B Beginning of line — CP moves to leftmost position on line.
- HOME Home — CP moves to top leftmost position of Forth screen.
- RETURN Return key — Do a carriage return line feed.
- CTRL-Z Zap to end of line — All text from CP to end of line is erased.
- CTRL-F Find — Search screen starting at CP position for a string that matches the contents of the editor buffer. (This routine is purchased separately.)
- CTRL-N iNsert mode is toggled on or off — Character input at CP location will push text on current line to right one position. . .last character on line will be lost. . .delete, valid character entry, control-G and control-N are the only commands recognized while in iNsert mode. . .control-G works the same. . .delete not only deletes the character to the left, but also moves text from CP to end of line left one position. . .control-N will toggle iNsert mode off.
- CTRL-Q Quit editing and return to Forth.

Three listings included. The first listing is for use with a standard CRT terminal. The second and third listings are for use with a Memory Mapped Video (16x64 and 24x80).

The above example reflects a transfer of line 3 to the editor buffer via control-T. The editor buffer contents can be read into any line occupied by Character-Pointer via control-R. This buffer never changes location and its contents are displayed at all times. It is very handy for relocating lines or moving lines from one screen to another.

Please note the "NSERT/ON" message displayed at the upper right to indicate that the iNsert mode has been toggled on via CTRL-N. This message is erased when iNsert mode is toggled off.

The TAB over count is stored as a variable so it can be changed at any time. The current value is always displayed to the right of 'TAB='.

CP location is maintained within the boundaries of the Forth screen at all times. Its value is always displayed to the right of 'CP='.

Memory requirements are well under 2K.

All code conforms to the Forth-79 Standard. Each line of code is fully explained and flow-charted (Forth style) for easy modification.

Bomb proof. . .all unused control codes are trapped.

Must be used with a CRT that has cursor addressing or with a Memory Mapped Video.

The FINDWD package is sold separately but space has been reserved in the EDitor for future insertion. It will prove to be an invaluable tool for finding a word or words in a screen or searching a wide range of screens. It is fully documented and flow-charted. We spent a tremendous amount of time on this routine and have cut the search time down to under a second per screen (for a screen that is already in memory).

**Send check or money order in the amount of \$50.00, payable to KV33 Corporation, and receive complete source code, flow-charts, documentation, and instructions for bringing up on your system.**

**FINDWD package is \$35.00. Must have the above screen editor to operate.**

**Please include extra postage for overseas orders, shipping weight 10 oz.**

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# VIC Expands Its Horizon

## RS-232 Interface Announced

### VIC-20 RS-232 Interface

Commodore has finally included an RS-232 interface in the new VIC-20, after several model PET and CBM machines. Since the RS-232 is much more common than the IEEE-488 interface, you should have less trouble finding printers, modems and other peripherals to connect to the VIC. Keep in mind, though, that a special adapter cable will probably be needed, since Commodore did not use a standard RS-232 connector. You should take a little time to understand how the new interface works before trying to use it.

The RS-232 interface has four levels of operation: the BASIC level (as seen by the program), the buffer system, the operating system byte/bit handling, and the special hardware required for proper voltage levels.

The BASIC-level interface uses the normal BASIC commands: OPEN, CLOSE, CMD, INPUT#, GET#, PRINT# and the reserved variable ST. The operating system byte/bit-level handler runs under control of 6522 device timers and interrupts. The 6522 generates non-maskable interrupt (NMI) requests that allow background RS-232 processing during normal program execution.

There are special software routines within the operating system to prevent disruption of data transfers by the RS-232 routines. Thus, during cassette or serial bus activities data cannot be received from RS-232 devices.

The VIC-20 RS-232 interface is bidirectional with a 256-byte first-in/first-out (FIFO) buffer for each direction. The opening of an RS-232 channel allocates these 512 bytes of system memory at the top of user memory. If there isn't enough free space above the BASIC program text, no error is indicated, but the program will be damaged. The INPUT# and

Address correspondence to Robert Baker, 15 Windsor Drive, Atco, NJ 08004.

GET# commands fetch data from the receiving buffer while PRINT# and CMD commands place data into the transmitting buffer. The buffer allocation is then reversed by a CLOSE command.

Only one RS-232 channel should be open at any time. A second OPEN statement will reset the buffer pointers, and any untransmitted or received data will be lost. Also, if an RS-232 channel is to be used, the OPEN command should be performed before any variable or DIM statements. The opening of an RS-232 channel also performs an automatic CLR command which will destroy any previously defined values. Remember that the

program will be destroyed if there are less than 512 bytes of space available at the time of the OPEN statement.

When the RS-232 channel is opened, up to four characters can be sent in the filename field of the OPEN statement. The first two are the control and command register values that determine how the interface will function. The last two are reserved for future system options and should be avoided at present.

The control register values select the number of stop bits (one or two), the serial word length (five to eight bits), and the data rate (50 to 2400 bits/second), as shown in Fig. 1. The command register

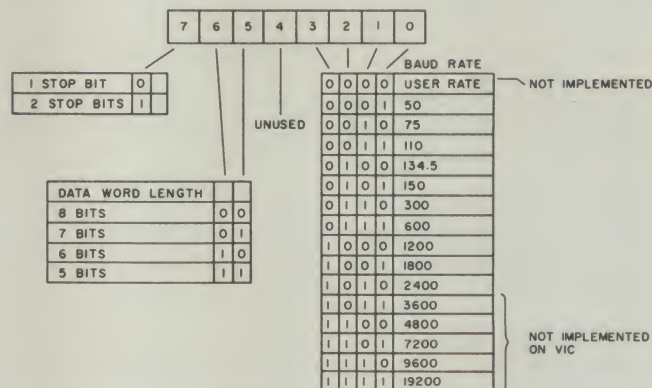


Fig. 1. VIC-20 serial port control register.

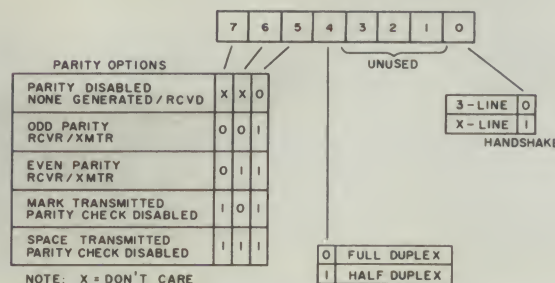


Fig. 2. VIC-20 serial port command register.



values select the parity options, full- or half-duplex mode and the handshaking options, as shown in Fig. 2.

These figures can be used to easily find the correct bit configuration when computing the control characters to configure the RS-232 port. You should be aware that there is no error checking on the control word to detect a non-implemented bit rate. An illegal value in the lower four bits of the control register will cause the system output to operate at a slow rate (below 50 bps).

When receiving data, the VIC system internal receive buffer will hold 255 characters before a buffer overflow is indicated in the RS-232 status (ST). If this occurs, all characters received while the buffer-full condition exists are lost. Keep in mind that BASIC is slow in normal handling of data, and frequent garbage collects by the operating system will probably cause the receive buffer to overflow. If you want to input data at high bit rates you'll probably need machine-language routines to handle the higher speed interfacing.

The normal GET# and INPUT# commands are used to fetch data from the receive buffer. If a GET# command does not find any data in the buffer, a null character ("" ) is returned as expected. When an INPUT# command is used, the system will hang until a non-null character followed by a carriage return is received.

If the RS-232 CTS or DSR control lines disappear during character INPUT#, the system will hang until it is restored. This is why the GET# command is highly recommended for fetching data from the VIC serial interface.

When sending serial data, the output buffer can hold 255 characters before a full-buffer hold-off happens. The system will wait in the output routine until transmission is allowed or the restore key is used to recover the system.

There is no carriage return/line feed delay built into the output channel, so some RS-232 printers will not print correctly unless some form of hold-off or internal buffering is implemented by the printer. If an RS-232 CTS handshake signal is implemented, the VIC buffer will fill and discontinue output until transmission is allowed. Or the program can send a number of null characters to allow an appropriate delay before sending another printable character. This was a common method used with older Teletypes for printing without fancy handshaking lines.

For example, assume you need a one-second delay after a carriage return and you are using a 300-bits-per-second interface. With ten bits per character (1 start + 8 data + 1 stop), that's 30 characters per second. Thus, sending 30 null characters following the carriage return will insure the printer has time to complete the operation and will be ready to print again.

If the printer finishes early, the null characters are just ignored, since they're nonprinting characters. Any characters sent while the printer was busy performing the carriage return just won't be seen by the printer while it's busy.

When you are through with the serial interface, closing the RS-232 file discards all data then in the buffers, stops all bit transmitting and receiving, sets the RS-232 RTS and Sout lines high, and deallocates the RS-232 buffers. You should be careful that all data has been transmitted before closing the channel. One way to check this from BASIC is:

```
100 IF ST = 0 AND (PEEK(37151) AND 64) = 1 GOTO 100
110 CLOSE 1F#
```

As shown here, the RS-232 status register can be read from BASIC using the ST variable following an operation to the serial channel. However, when ST is read the RS-232 status word is cleared. Therefore, you should reassign the value of ST to another variable if multiple compares are desired. Fig. 3 shows the meaning of the individual binary bits in the

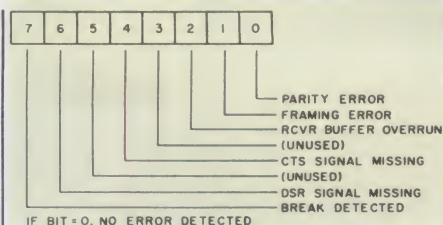


Fig. 3. RS-232 status register.

RS-232 status register. Remember that the value read is in decimal and must be converted accordingly.

For those who may be interested, I've included a list of low memory addresses used by the serial interface (see Table 1) and information on the various RS-232 control and signal lines (see Table 2).

## Two Disks

Having both 4040 and 8050 disks is a real luxury, but there is one small drawback. The disk drives are normally set as

Address	Hex	Dec	Usage
\$00A7	167		Receiver input bit temp storage
\$00A8	168		Receiver bit count
\$00A9	169		Receiver flag, start bit check
\$00AA	170		Receiver byte buffer/assembly location
\$00AB	171		Receiver parity bit storage
\$00B4	180		Transmitter bit count
\$00B5	181		Transmitter next bit to be sent
\$00B6	182		Transmitter byte buffer/disassembly location
\$00F7	247		Two-byte pointer to receiver buffer base loc
\$00F9	249		Two-byte pointer to transmitter buffer base loc
\$0293	659		Pseudo 6551 control reg (see Fig. 1)
\$0294	660		Pseudo 6551 command reg (see Fig. 2)
\$0295	661		Two-bytes following control and command in file name field (for future use)
\$0297	663		RS-232 status register (see Fig. 3)
\$0298	664		Number of bits to send/receive
\$0299	665		Two-bytes equal to time of one-bit cell (based on system clock and baud rate)
\$029B	667		Byte index to end of the receiver FIFO buffer

Table 1. Low memory addresses for RS-232 interface.

Pin ID	6522 Pin	Abv	Description	Line Interface
C	PB0	Sin	Received data	3 X
D	PB1	RTS	Request to send	3 X
E	PB2	DTR	Data terminal ready	3 X
F	PB3	RI	Ring indicator	
H	PB4	DCD	Received line signal	X
J	PB5	xxx	(Unassigned)	
K	PB6	CTS	Clear to send	X
L	PB7	DSR	Data set ready	X
B	CB1	Sin	Received data	3 X
M	CB2	Sout	Transmitted data	3 X
A	GND	GND	Protective ground	3 X
N	GND	GND	Signal ground	X

Table 2. RS-232 control and signal lines. (6522—location \$9110#\$911F)



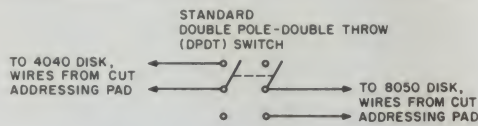


Fig. 5. Disk address select switch.

device #8 on the IEEE bus when shipped from the factory. When you have two disk drives, one drive has to be changed to another device address. You can only have one device on the IEEE bus that responds to a given bus address. If both disk drives are the same type, there's no problem—you or the dealer must simply change the internal address selection of one drive permanently and forget about it.

If you have two different disk types (say, a 4040 and an 8050), then a new problem arises. Most current disk software is written so it will only work with the disk addressed as device #8. Furthermore, some programs are only available for one particular drive. Modifying a major software product could be a rather complicated task, and then you'd have separate versions for each disk. You really don't want to permanently change the device address of either disk, since it would impose serious limitations.

One simple solution is to connect only one drive at a time, with both disks still set as device #8. This allows you to use any software package, but you have the inconvenience of having to switch cables to use a different disk type. Also, you've paid for two separate disks but you can only use one at a time.

I routinely test many different software packages that are written for many different configurations, and I've come across a much nicer solution that turns out to be extremely convenient. Basically, it involves connecting an external switch to one of the internal bus address select lines in each disk drive. When wired correctly, one disk will be device #8 while the other will be device #9. When the switch is changed, the device addresses are reversed. Thus, either disk can be the primary disk (device #8) while both disks are always available.

I would strongly recommend having your local dealer make any changes inside the disk drive if you're not skilled in these matters. Otherwise, be extremely careful near the disk drives themselves

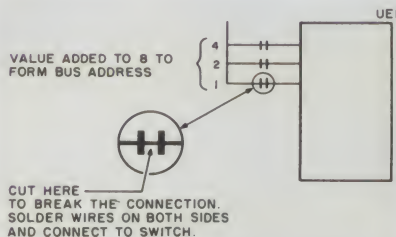


Fig. 4.

as they are very sensitive to dirt, vibration, etc. Also, the printed circuit board contains MOS devices that can be easily damaged by static electricity. It's best to leave the work to a trained technician if you're in doubt.

For whoever is doing the modification, the IEEE bus address is determined by three pads on the printed circuit board. They are located to the left of the IC marked "UE1" (see Fig. 4), and are in roughly the same location in both the 4040 and 8050 disks. These pads are normally shorted on the board, but may be cut to change the bus address as desired. Each pad has a binary value of 1, 2 or 4, as shown in the diagram. By cutting one or more of these pads, the corresponding value is added to 8 to create the new bus address. As expected, the disk must be device 8 through 15 on the IEEE bus.

To connect an external switch, you simply cut the bottom pad in both disks as shown in Fig. 5. Then carefully solder a wire to each side of the cut pad and attach to the external switch. When the external switch is closed the disk is device #8 as normal. If the switch is open, the

#### Hex location New hex data

\$039D	\$D3
\$03A4	\$D4
\$03CF	\$20
\$03D0	\$83
\$03D1	\$F1
\$03D2	\$60
\$03D3	\$40
\$03D4	\$20

Table 3. Hexadecimal values for updating Screen Print assembly-language program.

N:CORRESPONDING MEMORY DUMP															
N:FOR SCREEN PRINT ROUTINE FIX															
N:															
M:0384-03D4	0	1	2	3	4	5	6	7							
W:0384-038B	A2	04	8E	D4	00	20	BA	F0							
W:038C-0393	A0	00	A9	80	8D	98	03	8C							
W:0394-039B	97	03	B9	00	80	29	7F	18							
W:039C-03A3	2C	D3	03	F0	02	69	40	2C							
W:03A4-03AB	D4	03	D0	02	69	40	20	28							
W:03AC-03B3	F1	C8	C0	28	D0	E4	A9	0D							
W:03B4-03BB	20	28	F1	A9	0A	20	28	F1							
W:03BC-03C3	98	18	6D	97	03	8D	97	03							
W:03C4-03CB	90	03	EE	98	03	A0	00	C9							
W:03CC-03D3	E8	D0	C7	20	83	F1	60	40							
W:03D4-03DB	20	00	00	00	00	00	00	00							

Table 4. Corresponding memory dump for Screen Print routine fix.

disk will be device #9. The switch can be mounted wherever convenient. Mine is mounted on the back of one disk unit, out of harm's way. Maybe someday Commodore will make it easy for us by adding switches for device address selection.

## Screen Print Fix

In the May 1981 column I used a simple screen print program as an example while talking about machine-language programming. I mentioned in the column that the method used may not be the preferred way to use the IEEE printer from a machine-language program, but it does work.

A reader from Italy recently sent in a simple change to the routine that eliminates a minor problem. As written, the routine will leave the selected printer with the printer's LED on when the routine ends. This can be fixed by adding one more subroutine call at the end of the routine. However, the two constants after the routine must be moved and their references fixed to allow for the additional instruction.

To correct the source program, add a JSR \$7183 instruction just before the RTS instruction at the end of the routine. This changes the hex locations as shown in Table 3.

I've included new monitor displays and a disassembly listing to make things easier for those who may want to add the changes. □

```

N:SCREEN PRINT ROUTINE - FIX
N:FROM MAY '81 COLUMN
N:
D:0384-03D2      1 2 3  MNC-CODE
I:0384          A2 04    LDX  =#04
I:0386          8E D4 00  STX  $00D4
I:0389          20 BA F0  JSR  $F0BA
I:038C          A0 00    LDY  =#00
I:038E          A9 80    LDA  =#80
I:0390          8D 98 03  STA  $0398
I:0393          8C 97 03  STY  $0397
I:0396          B9 00 80  LDA  $8000,Y
I:0399          29 7F    AND  =#7F
I:039B          18      CLC
I:039C          2C D3 03  BIT  $03D3
I:039F          F0 02    BEQ  $03A3
I:03A1          69 40    ADC  =#40
I:03A3          2C D4 03  BIT  $03D4
I:03A6          D0 02    BNE  $03AA
I:03A8          69 40    ADC  =#40
I:03AA          20 28 F1  JSR  $F128
I:03AD          C8      INY
I:03AE          C0 28    CPY  =#28
I:03B0          D0 E4    BNE  $03B6
I:03B2          A9 0D    LDA  =#0D
I:03B4          20 28 F1  JSR  $F128
I:03B7          A9 0A    LDA  =#0A
I:03B9          20 28 F1  JSR  $F128
I:03BC          98      TYA
I:03BD          18      CLC
I:03BE          6D 97 03  ADC  $0397
I:03C1          8D 97 03  STA  $0397
I:03C4          90 03    BCC  $03C9
I:03C6          EE 98 03  INC  $0398
I:03C9          A0 00    LDY  =#00
I:03CB          C9 E8    CMP  =#E8
I:03CD          D0 C7    BNE  $03D6
I:03CF          20 83 F1  JSR  $F183
I:03D2          60      RTS

```

Program listing. Screen Print routine fix.



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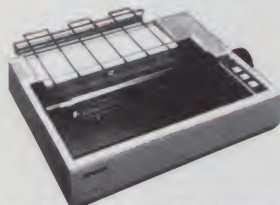
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# Modems to Keep in Touch

## The Gift of Communication From Hayes, Prentice

Christmas is almost here again! This month we will look at some terrific hardware and software you might want to find under your tree. We will also look at another new and interesting use of an information utility.

### A Modem under the Tree?

Would you like to find a modem under your tree? Here are two that can meet anyone's needs. I really love my Hayes Stack Smartmodem! I described it in detail in the August 1981 issue, but now I have lived with it for a while and I'm still impressed. This little box (Photo 1) will autodial and auto-answer with any terminal, or any microcomputer acting as a terminal—regardless of the software the terminal has inside.

The Hayes Stack Smartmodem is an intelligent peripheral device. You send it commands over the ASCII line from the keyboard of any terminal device. When it is off-line it will respond to a command such as AT D7037341387 by dialing that telephone number with rotary dial pulses. The "AT" means "wake up, modem!" The "D" tells it to rotary dial; a "T" would set it for tone dialing. You can instruct it to wait and mix dial pulses and tone dialing to meet practically any dialing situation. When it is on-line, you simply prefix your commands with an escape code to get its attention.

The modem will auto-answer after you give it a simple command such as AT SO=3 (answer on the third ring). It will wait for the third ring and then welcome whoever is calling with an answer tone. The speaker built into the SmartModem lets you hear the connection being made (either dialing or answering), and also operates under control of the Smartmodem software.

I'm not going to go into all of the details of how this device operates, but I will say that it should be number one on the

Christmas list of anyone who uses an RS-232C port for data communications. It is a well-built, easy-to-use device with full operating capabilities. Santa would have to pay about \$280 for a Smartmodem at his local computer store. The elves at Hayes Microcomputer Products, 5835 Peachtree Corners East, Norcross, GA 30092 can supply more information.

If you don't need a modem with all of those capabilities, the Prentice Star would be a nice thing to find under the tree with the toy soldiers and the dolls. The Prentice Corporation has been in the modem business for a long time, but most of their products go to the full-time heavy-duty communications market. The Star represents their new entry into the market of modems for personal or portable use. As Photo 2 shows, the Star is an acoustically-coupled device. It is well constructed, with deep cups for the telephone handset and a full complement of LEDs to show what is happening on the circuit. The switches and LEDs are conveniently placed in the front of the unit. The Star is available for under \$130 from several of the advertisers in *Microcomputing*. It is a commercial-quality acoustic modem at a "hobby" price. Contact Prentice Corporation at 266 Caspian Drive, Sunnyvale, CA 94086.

### The Apple II and CP/M

The CP/M operating system from Digital Research has grown in importance in the last few months. Xerox is using it in their nifty 820 system, and CP/M will be available for the IBM Personal Computer system despite IBM's acceptance of a different operating system as their standard. There are more microcomputers now running under CP/M than under any other single operating system.

It is only natural that the Apple II community would not be left behind simply because CP/M is an 8080 operating sys-

tem and the Apple uses a 6502 CPU. Microsoft came to the rescue with their Softcard for the Apple II which actually gives that system an extra Z-80 CPU. With the Softcard, Apple II users can run all of the CP/M software available and still play Raster Blaster in their spare time.

As Apple II+ CP/M owners grew to know and love programs like WordStar, they needed to be able to transmit and receive their CP/M files through a modem. Several capable programs are now entering the Apple II+ CP/M arena, including Crosstalk, which we discussed last month. But the first one on the market was Z-Term, written by Bill Blue.

### Z-Term

Bill Blue was (along with Craig Vaughan) one of the developers of the original Apple Bulletin Board software. Bill's focus has always been on providing software with a high degree of "human engineering"; i.e., software that's easy to use. His ASCII Express package for the Apple II has long set the standard for Apple terminal software programs. Z-Term is not a warmed-over ASCII Express; it is better.

Z-Term is written in 8080 assembly language. It has the features normally found in a smart terminal program, such as the ability to transmit and receive standard ASCII text files through a buffer (38K bytes in a 56K system) and transmit prepared files in either a line-by-line or character-by-character mode in response to prompts from the other system.

The program also provides for the use of up to 12 macro files which can automatically dial a telephone number (through the Hayes Micromodem II, SmartModem, Apple Lynx or the new Radio Shack Modem II), and transmit elements of information such as sign-on codes for the system being entered. Most of these capabilities are standard with the best terminal programs, but Z-Term



also has some features found in very few other terminal packages.

Z-Term can review the buffer while on line. The only other program I know of that can do this is Omniterm for the TRS-80. The ability to look back in the buffer is valuable to people using electronic mail systems. This feature improves the quality of electronic message exchanges because it lets you look back at the messages you have received and formulate more meaningful replies. Z-Term provides very flexible use of the buffer. The buffer can be examined, cleared, saved to disk or expanded

without changing the contents. This is a rare and valuable feature.

Z-Term also has some translation ability. Translation, in this case, refers to the ability of the program to change a received or transmitted ASCII character to a different character. Translation can be used to protect a printer from strange control codes, and to tailor a microcomputer to perform in certain ways.

Z-Term can tailor the Apple II to respond like a specific brand and model commercial terminal. This is particularly useful when communicating with time-sharing systems that have software writ-

ten for a particular terminal.

The Z-Term manual includes information on how to tailor the cursor movement, screen blanking, reverse video and other features to match those of common commercial terminals. (These terminal emulations require that you have an 80-column display card in your Apple.)

Z-Term is flexible in the way it handles its menu. The menu usually is not displayed, so the frequent user can zip right in and out of commands with little delay. If it is needed, however, the menu can be called immediately; it provides helpful guidance in using the commands. Z-Term is one of the best available terminal programs.

#### But Wait!

But Z-Term, as good as it is, now has a "big brother." Bill Blue has written an enhanced version of Z-Term called The Professional (Z-Pro). At this writing, I have not run Z-Pro long enough to award it the title of Best Terminal Package, but it's a prime contender. Z-Pro contains the protocol file transfer capability that Z-Term lacks. It also has unique handshaking macros.

#### Protocol Transfer

People seem to have taken two separate paths in their use of microcomputers as data communications devices. One type of system (generally non-CP/M) is used mainly for electronic mail functions and bulletin boards. Another type of system (usually running under CP/M) concentrates on file transfer protocols needed to exchange programs and databases.

Several handshaking protocols have been developed to ensure the accurate transfer of data. The protocols in use include the cyclic redundancy check (CRC) and the Christensen protocol (created by Ward Christensen, one of the CBBS developers). Some programs, such as ST80-III, written by Lance Micklus, take the middle course—they check the transmitted data against the received echo and warn of errors. But most terminal programs ignore error detection and correction.

Z-Pro seems to span both camps. It has the prompted file transmission common in terminal programs and the error detection and correction found in the dedicated file transfer programs. Z-Pro will also support the PAN electronic mail format. (See last month's column for a brief discussion of PAN.)

Z-Pro also has something completely new: interactive macros. Most macro files (including those in Z-Term) are simply files of data that are prestored and transmitted out of the modem port at the appropriate time. The first bytes often cause a modem to dial a number, and the remaining bytes may transmit a sign-on or directive code, but the timing of most



Photo 1. The Hayes Stack Smartmodem is a complete auto-answer and autodial RS-232C modem that needs no software in the terminal to operate at its full capabilities. A Z-8 microprocessor runs its own internal program which responds to commands sent over the RS-232C data line.

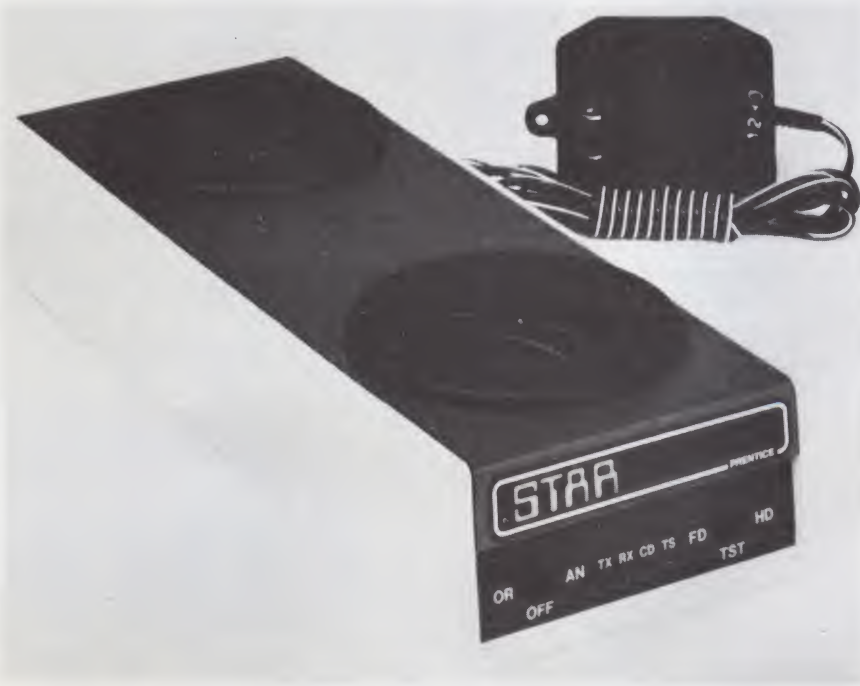


Photo 2. The Prentice Star modem is a high-quality acoustically coupled device for computers with an RS-232C port. It features switchable originate/answer and full/half-duplex operation. Various test features and a full set of diagnostic LEDs enhance its operation.







# THE WORLD IS YOURS



Data communications can open up a whole new world to you and your computer. A world of the future. Now. A world full of information resources, time-sharing computer systems, and electronic "bulletin boards." All you need for admission to this world is your CP/M<sup>2</sup>-based computer, a modem, and the proper software. That's where we come in. We have the proper software. **CROSSTALK**,<sup>™</sup> our smart terminal & file transfer program for CP/M, allows you to call into thousands of dial-up computer systems around the world, and communicate with them. **REMOTE**, our CP/M remote console program, allows you to operate your CP/M system from a remote terminal, giving your computer added flexibility and usefulness.

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- Simple, easy to use "plain English" command structure makes **CROSSTALK** easy to learn, yet provides a powerful tool for exchanging files, capturing data, and controlling modem parameters.
- Concurrent printer and video allows you to print data while viewing it on the CRT.
- Fully error-checked file transfers using 16 bit CRC protocol. Protocol transfers allow exchanging files which are larger than the system's memory.
- Built in "DIR" command.
- Data capture allows saving received data onto your disk.
- Auto-dial, redial, and auto-answer (if supported by modem).

Available for the following modems: Hayes 80-103a

Hayes Smartmodem<sup>™</sup>

Hayes Micromodem 100<sup>™</sup>

PMI Communications MM-103

Hayes Micromodem II<sup>™</sup> for the Apple II<sup>®</sup>

Any RS-232 modem, including 1200 baud modems

## REMOTE

- Allows **remote** use of your computer from a **remote** terminal location.
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- Provides nulls if needed for printing terminals.
- Uses less than 1k of memory space.
- Automatically selects proper baud rate.
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# The Value Of Models

## Aids in Solving Problems

### Mathematical Models

You are already familiar with many different types of models—model airplanes, model ships, model cars, doll houses, or even dolls themselves. One model is usually called "better" than another if it is more realistic. For example, toy dolls, which are intended to be models of real people, are made to walk, to blink their eyes, to have real hair, and to have many other properties of the people they represent.

All models, however, are not just toys. Scientists, engineers and mathematicians try to model all aspects of space travel before a rocket is launched. If a model spacecraft is found to be unsafe before the actual spacecraft is built, then not only money and time, but human lives can also be saved. Political candidates and the news media try to model the voting patterns of people so they can predict the winners of important elections. The design of a new airplane, the results of rapid population growth, the durability of a new product, the widespread effects of building a new dam, and many other very complex problems are modeled by very serious people with very elaborate equipment.

With the assistance of the rapid computation speed available on modern computers, the usefulness and accuracy of models has increased sharply. Many modern models are mathematical models. A mathematical model for the design of a new airplane wing does not look very much like an airplane wing, but consists of a series of expressions and equations that represents the new wing. The model also represents the many different factors such as air pressure, air speed, temperature and altitude that can affect the wing's performance. With the aid of the computer, a mathematical model can simulate the behavior of the new wing under many different operating conditions. After the mathematical model indicates that the new wing design

is acceptable, then a more conventional model that looks like a wing can be constructed and tested in a wind tunnel.

In other applications mathematical models can simulate relationships that are impractical or impossible to simulate with physical models. The long-term effects of several different techniques for treating a polluted river cannot be reliably simulated with a physical model. However, very realistic mathematical models can be constructed. First the mathematical models indicate the most effective treatment. Then the actual stream can be economically treated using the technique that has already been proven successful in model form.

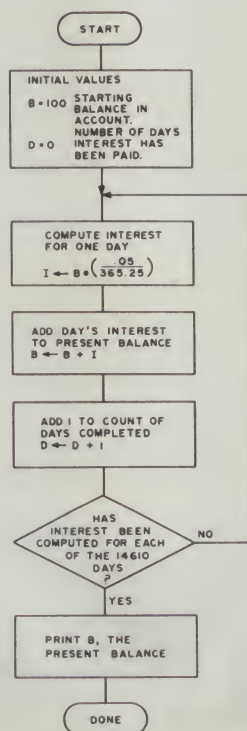


Fig. 1. Algorithm to determine the balance in a savings account.

Let's examine what appears to be a simple but useful mathematical model. Suppose that while cleaning the garage, Dave's mother finds a bank book in an old suitcase. The book shows that a single deposit of one hundred dollars was made in a local bank on April 1, 1941. The book was probably then lost, since there are no other entries. The account indicates that the bank pays an annual interest rate of 5 percent, which is compounded daily and added to the account quarterly on January 1, April 1, July 1 and October 1 each year.

Dave is anxious to take the book to the bank to discover how much money the account now contains. Since today is April 1, 1981, exactly 40 years' worth of interest should be added. However, since today is also Sunday and he must go to school next week, his curiosity may not be satisfied before next Saturday.

Fortunately, his problem can be solved with the help of a mathematical model and the computer facilities at his school. The total balance of any savings account (started with A dollars, to which an annual interest rate of P percent is compounded T times per year for Y years) can be obtained using the expression:

$$A \left( 1 + \frac{P/100}{T} \right)^{Y \cdot T}$$

Since Dave knows the value of each variable:

A = 100 dollars  
P = 5 percent  
T = 365.25 days per year  
Y = 40 years

the expression can be used to determine the current balance of the old savings account. By substituting these numerical values into the expression, he obtains:

$$100 \left( 1 + \frac{5/100}{365.25} \right)^{40 \cdot 365.25}$$

which can be written as:

$$100 \left( 1 + \frac{.05}{365.25} \right)^{14610}$$

This expression, evaluated using a calculator or the very short BASIC program:



represents a balance of \$738.28. The expression  $A(1 + (P/100) \div T)^{(Y \cdot T)}$  is a mathematical model that can be used to determine the balance in a savings account without using any money, without consulting a bank, without waiting for several years to elapse, and without even having a savings account.

Another model for computing this same balance, and one that does not depend upon knowing a special expression, is the algorithm shown in Fig. 1. This algorithm is represented by the BASIC program:

```
10 LET B = 100
20 LET D = 0
30 LET I = B*(.05/365.25)
40 LET B = B + I
50 LET D = D + 1
60 IF D <= 14610 THEN 30
70 PRINT B
80 END
```

The balance output by a run of this program is \$738.905. Unfortunately, Dave is confused because these two models do not yield the same balance. To make matters worse, his mother went to the bank, which computed the current balance of this account as \$738.88. Why did the models indicate balances of \$738.28 and \$738.905, when the correct balance is \$738.88? Since the better model is the more realistic one, Dave is anxious to learn why neither model gave the exact answer. His mother observed the following ideas that were not correctly simulated by Dave's model.

1. The number of days in a year is not 365.25, but exactly 365 days except during leap years. During leap years there are exactly 366 days. This means that the daily interest payment should be  $B \cdot (.05/365)$  or  $B \cdot (.05/366)$  depending on the year. During the years 1933 through 1973 there were ten leap years—1936, 1940, 1944 and every fourth year thereafter.

2. The bank adds interest payments to the account four times each year. The balance is always rounded to the nearest cent when the interest is paid. The balance is not rounded to the nearest cent in either of the two models.

A mathematical model that includes these two ideas would be more complicated, but would yield the correct balance. In fact, most banks use computers and similar mathematical models to compute the current balance of all accounts. Whenever a mathematical model is created, you must exercise extreme care to make the results as accurate as possible. If the model is not 100 percent accurate, the percent error of the model should be calculated.

Dave's mother was also concerned about another question, but she wasn't sure how to explain the problem to him. After he had initially obtained two different answers on his TRS-80, his mother asked her friend to do both computations on her Apple. Unfortunately, the Apple

produced 738.80 and 738.905, respectively. When she then tried to use the PDP 11/70 at the local college, she was confidently given yet a third pair of answers, 738.47 and 738.905. She was confused as to why three different computers would calculate three different values for the same mathematical expression. An explanation of this will be the subject of a future column. For the moment, however, be advised that you should not assign a programming problem to students without first attempting to solve that problem. And you must never label a student's answer incorrect without considering the possibility of computational error that the student was not prepared to anticipate.

### Homework Assignments

As promised last month, let's now examine a few problems appropriate for student solution with computer support. None requires any more mathematical background than a few months of algebra.

1. Doris is studying the population growth of a certain type of fly in her biology class. She begins her experiment

Let's now examine  
a few problems  
appropriate for  
student solution  
with computer support.

with ten flies, and has predicted the following pattern to the population growth:

- Each month, every pair of flies can produce exactly ten new pairs of flies.
- After producing their offspring, the parent flies always die.
- Twenty percent of the pairs of flies born each month will die without reproducing.

A. If Doris conducts her experiment for the entire ten-month school year, exactly how many flies will be alive when she finishes her work?

B. Write a program that will allow a user to enter the number of flies at the beginning of the experiment and the number of months that the experiment will last. The program should then calculate and display the approximate number of flies expected to be alive when the experiment concludes.

Notice that this problem can be solved without any flies and without waiting ten months. The problem should be solved by creating a mathematical model that simulates the fly population.

2. A program that models the Gregorian calendar can be both fun and

interesting. Although the Gregorian calendar is very accurate—an error of only one day in 3320 years—it is only based on a few simple facts.

● There are 30 days during April, June, September and November; 28 days during February except in leap year when there are 29; and 31 days in all other months.

● Leap years are those years that are divisible by 4 but not by 100 or are divisible by 400.

● January 1, 1800, was a Wednesday.

● The calendar will repeat every 400 years.

Using these facts you can write programs that: print a calendar for any given year; determine on which day of the week a particular date did or will occur; or print any information that can be determined by looking at calendars. For a specific task, write a program that will permit a user to enter the month, day and year of any date after January 1, 1800. The program should then print the day of the week that corresponds to the given date. The output from a run of your program might appear as:

```
RUN
? 10, 2, 1939 represents October 2, 1939
MONDAY
```

3. Suppose you are a baseball manager in the unhappy situation of having an entire team with individual batting averages of .220. To make matters worse, when a player gets a hit there is only a one-tenth chance that the hit is a double rather than a single. What is the average number of runs your team will score in a nine inning game? Assume that a single will advance each runner one base while a double advances each runner two bases.

After answering this question you may be interested in expanding your program so the nine different batting averages of an entire team can be entered. By doing this and running several simulations, you can discover the most effective batting order. When properly used, computers can make positive contributions in some unexpected areas. What other functions of a baseball manager might a computer assist?

4. Suppose you must cross a 1200 mile desert in your jeep. The gas tank holds 30 gallons and you are confident of obtaining 15 miles per gallon. At your home on one side of the desert you can obtain all of the gasoline you require. What is the minimum number of gallons required to cross the desert? No, the answer is not that you can't go further than 450 miles, nor is the answer a trick. If you need help, consider the methods used to climb Mt. Everest.

Mathematical models and simulations are playing an ever-increasing role in our lives. Providing students with the background and facilities for creating their own models should be an integral part of today's science and mathematics classes. □



# Put on Your Running Shoes

## Nike Lab Uses Micros For Research

### Nike Goes Micro

The treadmill rotates tirelessly as the runner strides on its platform, running hard but never moving ahead. Off to the side, two men sit in front of a tangle of machinery, looking at dials, screens and only occasionally at the lonely runner himself. One of the men turns a dial and the platform of the treadmill angles upward ever so slightly. The runner suddenly finds himself moving backward and must increase his efforts to stay in place—at the cost of a greater expenditure of energy.

Soon, the runner, breathing into a plastic mask connected to a flexible tube, begins to falter and, with a wave of his left hand, signals that he has had enough. The treadmill slows to a halt. The second man types a few keystrokes into an Apple microcomputer and reports, "In a minute we'll know your  $VO_2$ ."

These men, exercise physiologist Jack

Daniels and technician Jamie Larsen, work for Nike Corp., one of the world's largest manufacturers of shoes for runners. The tests they perform on the runners who visit the Nike Research and Development facility in Exeter, NH, are helping them amass data to better understand the dynamics of endurance exercise and running efficiency. To help in these tasks, Nike uses an Apple microcomputer.

The Biomechanics Lab, under the direction of E.C. (Ned) Frederick, originally acquired its Apple as a backup to its Digital Equipment Corporation PDP-11/34 minicomputer—the Apple can easily communicate with its larger brother. The Lab was also looking for a portable device. Daniels and Frederick plan to use the Apple in outdoor running tests designed to measure important physiological factors under real conditions. Since the computer was obtained, the personnel at Nike have found an increasing number of ways to use it.

### Running Efficiency

The Apple's principal role at present is to monitor the tests of running efficiency performed by Daniels and Larsen. These tests, conducted on the treadmill, measure efficiency by analyzing the gases exhaled by the athlete while he runs. His exhalations are trapped by a mask on his face, and fed into an oxygen analyzer and a Beckman carbon dioxide analyzer. These devices are connected electronically to an analog-to-digital converter, then a controller and finally to the Apple computer via its RS-232 interface.

Using a program called Classical Gas, the Apple calculates the ratio of oxygen to carbon dioxide in the runner's exhalation and compares these figures to the quantities of these gases in the free air. It then calculates how much oxygen the runner is using. Its calculations are displayed in milliliters of oxygen per kilogram of body weight per minute.

When a runner is forced to cross over from aerobic (with oxygen) to anaerobic (in the absence of oxygen) modes of burning energy, increasing amounts of oxygen do not produce greater energy. It is at this point that the runner reaches his maximal oxygen uptake, or  $VO_2$  max. For an endurance athlete like a runner, this is his highest level of efficiency.

The Classical Gas program, written in BASIC by Jamie Larsen, is just one of several that the Nike Lab has produced. Another program, called Fat Factor, calculates from height and weight a relative measure of an athlete's ideal weight range. IMP is a statistical model that simulates the effect that weight, height and running speed have on impact forces. Race Organization is a program under development to help score cross-country races and print out results. Impact Library is a data file on the variety of materials used in Nike shoes, storing information on rebound time, compaction characteristics, energy loss and other factors.

All work makes for dull guys so the boys in the lab have come up with Race



*An Apple plays a key role in the Nike lab.*



Invaders, a game for athletes (still under wraps in a dark corner of the lab).

Undoubtedly, however, the lab's most famous program is its Performance Predictor. This program estimates from previous race times a time for any other distance. Nike used the program at the 1981 Boston and New York marathons to predict the times of hundreds of runners. In Boston, the program predicted winner Toshihiko Seko's time within 20 seconds. For most other runners in the race, predictions were within two minutes, even for finishers in the four-hour range. Many runners wrote to Nike after the event to report their time—and many apologized for not finishing in the time predicted!

### Manufacturing and the Apple

The Nike Lab has passed the word to the rest of the company that a versatile microcomputer is a valuable tool. The company is now developing programs to analyze the data collected in its wear-testing project. This project is designed to help Nike evaluate the comfort and wearability of its new prototype shoes, using over 2000 volunteer runners around the country. The research and development facility plans to use an Apple to track the progress of its prototypes through the manufacturing process, including keeping track of inventory. The marketing division feeds data from surveys of preferred colors, customer surveys and biomechanical questionnaire results to Exeter and the Apple is used to analyze and organize the statistics that result.

All this information guzzling goes into the production of shoes that can theoretically improve performance. Nike now offers 35 different models of running shoes, many designed for specific classes of runners.

Even though the search for new knowledge about the physiology of running continues, Ned Frederick cautions: "We are at about the same stage that the American auto industry was in the early 1950s. We're just beginning to perceive just how much we don't yet know."

With an Apple at its core, the search goes on.

**G. Michael Vose**  
*Microcomputing staff*

### English Computing Show Draws 16,000

The rush to personal computing is on in England, as shown by a turnout of 16,440 persons for the fourth annual Personal Computer World Show, Sept. 10-12 in the Cunard Hotel, London.

Compare that kind of response with the 30,000 who attended the seventh Computer Faire last April in San Francisco, the heart of the world computer community, and you get some idea of just

how interested the British have become in personal computing.

Three key factors are at work:

- The availability of cheap, useful machines such as the Sinclair ZX-80 and ZX-81 and the Acorn Atom, all of which offer true (if limited) computing for less than \$300.

- The British Broadcasting Company's upcoming computer literacy series, complete with tutorials based on a special BBC Microcomputer, which was on display at the show.

- The Prestel home television/computer system, which, while still beyond the economics of most English families, has created large awareness and intense interest in individual interaction with personal computers.

The organizers of the PCW show, sponsored by England's largest computing magazine, had given much attention to organization, but even they didn't expect the turnout that saw a quarter-mile long line awaiting admission the first day. The

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No one expected  
the turnout that  
saw a quarter-mile  
long line waiting  
the first day.

---

show occupied two exhibition floors of the Cunard—with recreational exhibitors on the lower floor and business hardware and software on the upper level.

Represented among the almost 100 exhibitors were user groups, hardware manufacturers, software publishers, magazines and even an instant copying stand, kept busy churning out photo reproductions of manuals purchased by one visitor who just wanted the extra copies for "backup."

Among the busiest stands was the Tandy booth, which dominated the upper level, with its full range of demo TRS-80s. In an England sorely pressed by a soft economy and high inflation rates, the Tandy machine may be the top of the line—along with Commodore ("Don't call it PET. We've outgrown that image!") and Apple.

Clive Sinclair, who stirred things up last year with his ZX-80 (50,000 units sold at \$200 each), was back with the ZX-81. Priced even lower than the first generation, at about \$100 for a kit version or \$150 assembled, the ZX-81 uses only four chips, has an 8K BASIC ROM and is expandable with 16K plug-in RAM pack.

Another low-end piece of hardware on display was the Acorn Atom, available in kit for about \$200, and assembled for

about \$270. The bare-bones Atom, using a 6502 CPU and offering a 16 by 32 video display, features 8K of ROM and 2K of RAM. It has its own peculiar AtomBasic, which does not allow READ...DATA operations, which offers two bewildering PRINT statements, and which precedes string handling operations with the \$. The Atom was designed to be expanded, and offers such upgrades as 1K RAM sets at \$15 each, a 4K floating point ROM at \$35, printer driver at \$25 and color encoder and buffer at \$36.

The Atom was selected by BBC as the mode for its Microcomputer, much to the chagrin of Sinclair, who grumped at the time: "What the BBC is doing, it is doing badly."

The BBC micro, slightly more expensive than the Atom, seems to be a lot of machine. It has a 73-key QWERTY full-travel keyboard and 16K of ROM, uses Microsoft BASIC, has 32×40 or 25×40 video output and supports color graphics up to 320 by 256 on a standard European PAL system television receiver. In addition, the Model B, the top of the line, offers 32K of RAM, 640 by 256 color graphics, a Centronics-type parallel printer port, a RS-423 serial interface compatible with the RS-232C and the ability to network with up to 255 other users.

Another machine unfamiliar to the States worth mentioning is the DAI personal computer, from Data Applications International of Brussels. It was born under a development agreement with TI. TI then walked away from it and Data International, whose main business is industrial controls, was left wondering what to do with a high-performance color and sound generating machine that could be sold for around \$1100. They figured it out.

The machine is based on the 8080A microprocessor and is available with up to 48K of RAM, plus 24K of bank switched ROM that contains the resident software and a BASIC interpreter that emulates Microsoft, monitor and other housekeeping functions. Housed in an integral full-travel keyboard, the machine features 16-color, 256 by 336 high-resolution graphics, stereographic sound generation, and plugs for everything except your electric shaver. The interfaces include game paddle sockets, dual cassette input, and RS-232C and DCEbus interfaces.

If there was a noticeable shortcoming in the show, and perhaps in British personal computing as a whole, it was in the area of software. One dealer explained: "It seems that we have to import it all, either from the States or the Continent, and then translate it. You Yanks don't even know how to spell programme."

As might be expected, most of the software on display was aimed at the small machines mentioned above. The business software was largely Apple and Tandy, with only a few offerings in CP/M and



other larger-system formats

One of the major such offerings was Silicon Office, billed as a complete office management system—word processing, payroll, financial, etc.—one package. The problem, according to a competitor, is that it is "designed for a machine that doesn't yet exist (the Commodore 9602)."

The second major piece of software, which drew large crowds to its Tandy-machine demonstration area, was The Last One, a code-generator first introduced in San Francisco in April and which has been supported by what is believed to be a million-dollar advertising budget. Michael Falter, vice-president of marketing for DJ "AI" Systems, Inc., the publisher, would not deny nor confirm the published report that about \$9 million in orders have been taken for the program, which was expected to be shipped in October.

The user groups and club displays were constantly active signing new members. The magazine publisher booths sold briskly. (Tip to show-goers: Wait till late afternoon of the last day. You can get two, three or four for the price of one. No publisher wants to carry all those back issues home again.)

The second annual Microcomputer Chess Championship was won by a homebrew program that brushed aside all five of its opponents in the 12-entry

field, which included such popular and well-known systems as Gambiet 81, Philidor and Chess Champion Mark V.

Richard Lang, who wrote Cyrus in about six months of spare time, is a 26-year-old research programmer for the English natural gas utility. His winning program, written in Z-80 assembler language, occupies just over 7K of memory and includes an opening book table of 1.25K which "I took straight out of the Penguin paperback of chess openings."

According to Michael Stean, an international master, the program is particularly exciting in its ability to mount powerful coordinated attacks using numerous pieces, without the emphasis on the queen shown by many programs. Cyrus's end-play capabilities are a matter of conjecture, however; Lang noted, "He usually doesn't get that far before winning." All five games in the tournament were won in the middle game.

When last seen, Lang was fending off potential marketers, and saying, "Version 2, which is almost finished, will be considerably stronger."

As the show wound down on a glorious fall Saturday afternoon, David Tebbutt, former editor of PCW and now President of Caxton Software, Ltd., and the man who spurred these first four PCW shows, said: "It looks like they'll be seeking much bigger space next year."

And who knows what Sinclair will be offering then?

**By Edgar F. Coudal**  
**Special to Microcomputing**

## RFI Regs Defeat Compucolor II

The Federal Communications Commission's new radio frequency interference regulations have claimed at least one victim in the microcomputer world.

Intelligent Systems Corp. has decided to pull its Compucolor II from the U.S. market. The reason: changes required to meet the FCC's class B standards would cost too much money.

"The Compucolor II was not especially profitable for us to begin with," says Susan Sheridan, ISC's manager of marketing communications. "When the FCC came up with its ruling, we looked into what changes would be required, and decided that it would cost too much in money and resources."

Sheridan says that the necessary changes were probably no more involved than those made by Apple or other companies. But, she adds, Apple's Apple II was making too much money to be pulled from the market. The Compucolor II has not brought in enough revenue to make the investment worthwhile.

Much of the problem lay with a lack of manpower, Sheridan says.

"For example, we would have had to change the analog board," she says. "At the time, we were designing a new analog board for our other computers, and it would have meant pulling one of our engineers from that project."

Also, says Sheridan, ISC has a computer in its Intecolor series which is in a price range to be used as a home computer.

The Compucolor II is based on the 8080A microprocessor, and includes 8K, 16K or 32K byte models. Its base price is \$1895-\$2495, and is targeted for the home and school market.

Although the micro will no longer be sold in the U.S., the company has promised to maintain customer support. It will still publish *Colorcue*, a bimonthly magazine for Compucolor and Intecolor owners, and provide parts and repair.

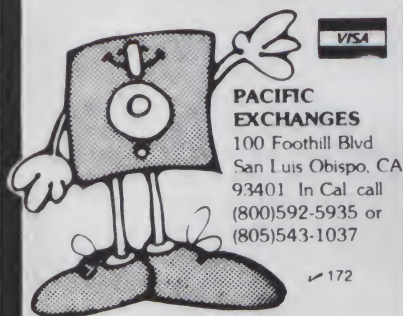
ISC will continue to market the Compucolor II in Europe.

The FCC regulations require that Class B computing devices—those intended for home use—meet stringent regulations to control potential interference with other electronic and communications devices. The major micro manufacturers—including Apple, Radio Shack, Ohio Scientific, Commodore and Atari—have received certification for their micros.

A complete story on the new regulations appeared in *Microcomputing's* April issue ("FCC Takes Aim Against RFI Polluters," p. 30). □

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# LETTERS TO THE EDITOR

## You Have Won A New Ferrari!

In your Sept. issue you had a fascinating piece on instant mail (Publisher's Remarks, p.6). The article touches on the fly in the ointment of instant mail—the junk mail problem. Can you imagine the benefit to the direct mail advertiser of a message that must be at least partially scanned? Currently you can pretty well tell if a letter is junk mail and trash it unread or at least defer it. With the use of electronic mail you will need to read at least part of it to determine content, and at that the probability of sales multiplies.

Please do not interpret this as nit-picking. It's merely that I can see logging on my home terminal and immediately getting a raft of messages—most of them to the effect that I have won a Ferrari, a Cessna, a new home or a solid walnut toothpick if I will visit some dumb development. Since buried in this mass of mail may be a letter informing me the city has tripled my property taxes, or I have inherited controlling interest in a major oil company, none of the mail can be ignored, so I will be stuck with reading at least some part of each piece.

The economics for the personal or business mailer would have the advantage of finer demographic targeting with area-code-prefix coding. They would be able to buy a couple of WATS lines, program their computers to dial the selected area and prefix and deposit their message in every mailbox for that prefix. With the development of standard protocols and low-cost fax equipment, the transmission of pictures, graphs and other brochure equivalents, perhaps even in color, could go along with the mail. All designed to capture the attention of the reader.

The avoidance of this corruption of what is really a potentially outstanding tool will require a great deal of thought. Such techniques as capturing and passing through the originating number with the receiver being able to program his site to ignore WATS originated entries are possible but would compromise some of the system's value. I would hold out no hope of governmental regulation since the direct mail people have such a strong and well-financed lobby.

Another possible control would be for the subject to provide all the possible mailers with a priority number or code controlled by him. The program at the terminal would scan for such codes and direct the mail to the appropriate bucket, each of which could be scanned at will.

Those pieces not having a priority would be put in a file 13 equivalent that would be looked at when nothing else is going on (or dumped). Obviously creditors would not be given one of the high priority codes.

As an old-timer (nearly 25 years) in the use of computers, I long ago learned that very little comes up as clean and uncluttered as initially envisioned. However, as an old-timer I have long since learned not to put any limit on what can be done. Therefore I am in full accord with you that direct mail will be accomplished and indeed look forward to seeing how it is done.

**Richard J. Kelley**  
**Sapulpa, OK**

## Electronic Mailbox Now

Mr. Green's plea for an electronic mailbox in September's "Publisher's Remarks" has already been answered, at least in part. British Telecom has even implemented the encoded dictionary that he envisioned.

For background information: Prestel adapters cost about \$260 and up. TVs with adapters are available from rental companies. A local telephone call is about 7 cents for two minutes at peak time, falling to seven cents for 12 minutes from 6 PM to 8 AM.

**R. Larkin**  
**London, England**

## Speed Up FILEMAP

I was very excited about the FILEMAP program found in your September 1980 issue ("FILEMAP," by Douglas L. Jones, p. 166) because many of my programs are in excess of 17K and there are hassles involved in hunting down variables whenever extensive changes must be made.

Therefore, I entered this program onto my system for a try. I found somewhat to my disappointment that the program is slow.

After close examination of the program, it appeared subroutine 1100-1120 could be speeded up. The main problem as I saw it was the RESTORE usage and the serial search for the BASIC command string. From the typical list of BASIC commands one can find a reasonable alphabetical distribution of them.

The task was easy. Read in all the BASIC commands into an array. Set up a second array containing the alphabetical pointers (see lines 185-195 in Listing 1).

The second half of the problem was adapting this approach to subroutine 1100-1120. This subroutine improvement simply checked the first letter of the string and then would serially search BASIC commands beginning with that letter. For example, if the first letter of the string SSS was O then the subroutine would compare OCTS, ON, OPEN, OR and OUT thus skipping ABS, AND, . . . etc. until it got to OCTS. Obviously, this

*(continued on p. 211)*

```
185 DATA1,7,7,21,33,43,50,53,54,60,
      60,61,74,81,86,91,96,96,105,116,
      121,125,129,129,129,129,129,129
190 CLEAR5000:DEFINT A-F:BS=129:CX$=CHR$(12):DIMCH$(BS),CC(27)
195 FORJ=1TOBS:READCH$(J):NEXT:FORJ=1TO27:READCC(J):NEXT
1100 FL=0:N=ASC(S$):IFN<65ORN>91THEN1115 ELSE N=N-64
1105 FORNN=CC(N)TOCC(N+1)-1:
      IFLEFT$(S$,LEN(CH$(NN)))=CH$(NN)THEN
          FL=LEN(CH$(NN)):T=FL:NN=CC(N+1)-1
1110 NEXT
1115 IFFL<>0THENS$=RIGHT$(S$,LEN(S$)-T):S2$=""
1120 S=LEN(S$):RETURN
1300 'SPOOL
1310 WIDTH80
1320 INPUT"DO YOU WANT (C)RT OR (L)INE PRINTER OUTPUT";F3$
1330 IFF3$<>"C"ANDF3$<>"L"THEN1320
1340 OPEN"I",1,F2$,0
1350 IFEOF(1)THEN1390
1360 LINEINPUT#1,A$
1370 IFF3$="C"THENPRINTA$ ELSE LPRINTA$
1380 GOTO1350
1390 CLOSE
1400 END
```

Listing 1.



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† Microcomputers for Business Applications, 1979

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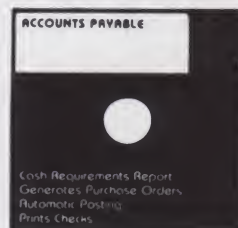
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# Everyman's Computer System

By John McKown and Steve Sarns



*The 8073 single-board computer system.*

If you haven't yet taken the plunge into microprocessors, here is a system that can make a beginner successful. You can assemble the computer and be programming it on the same day. If you're considering an intelligent home-security or energy-management system, you can build a low-cost system that won't tie up your not-so-low-cost personal computer. Changes to software can be made in one-tenth the time of most single-board computers, because this one talks an English-like BASIC language.

The system is designed to overcome the problems we've met in dealing with a variety of controller products. The number of computer applications in our company has skyrocketed over the last few years. Our non-product uses include controlling production equipment, running lab experiments, automatic printed circuit (PC) board testing, data logging and assisting test techs with tedious calibrations.

Usually, we've contracted with outside consultants to design and install systems. We now have a hodgepodge of custom designs with half a dozen different microprocessors. The documentation has been cryptic or worse, forcing us to rely on the designers for servicing. Since few of our people can program even one microprocessor in machine language, the biggest headache has been making software changes. Even so, it couldn't be done on the production floor where real-time tweaking is a must.

---

*John McKown and Steve Sarns are engineers at Cobe Laboratories Inc. 1201 Oak St., Lakewood, CO 80215.*

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Once again, we had to rely on the outside organizations to make even minor changes.

What we needed was a universal microprocessor system that was sufficiently simple so both our engineers and technicians could handle the hardware and software. Yet, it had to be powerful enough for most of our applications. Since we owned a lot of examples of what we didn't want, it wasn't difficult to develop the following criteria:

- Circuitry had to be readily understood by a wide range of personnel.
- It had to be programmable by nonprogrammers.
- It had to be field-programmable with nonvolatile memory.
- It needed a simple, inexpensive power supply.
- It had to be plug-replaceable, easy to package and serviceable.
- It needed sufficient I/O for most applications.
- It had to be easily expandable.

Since the system would be operated by personnel with little or no microprocessor experience, a high-level language was mandatory. We decided that a small BASIC interpreter would be ideal. To possibly simplify the circuitry, we also looked at several central-processor unit (CPU) chips with integral BASIC interpreters. Unfortunately, many Tiny BASICs have inconsistent syntax and lack meaningful error messages. However, we found an enhanced version that looked very good.

The design of a system was not yet a company project, so we got together nights and weekends to work out the hardware configuration. After trying several schemes, we settled on what appeared to be the least complicated

version. The circuit can be wire-wrapped on a 4.5 by 4.5 inch PC card, but we used a standard 4.5 by 6.5 inch card so that some breadboard space would be left. Two cards were made and run through their paces independently. We then wrote a set of utilities that would make the card a "tiny" development system.

Of the several CPUs with resident BASIC interpreters, the National Semiconductor INS8073 is by far the easiest to use. It's hard to imagine a bus and control structure more straightforward than National's MICROBUS. There are no multiplexed address and data lines and no tricky timing requirements, and it readily interfaces with all the common peripheral chips. NSC Tiny BASIC was developed specifically for control applications and has been used for several years with SC/MP and 8080 processors.

(This interpreter was originally called NIBL. All references to BASIC in the remainder of this article will be NSC Tiny BASIC.)

## The Microprocessor

This microprocessor supports a classic eight-bit bidirectional data bus and a 16-bit wide address bus. Three active low I/O strobes are provided. The Read (NRDS) strobe transfers data from the data bus into an internal register. The Write (NWDS) strobe occurs when the data put on the bus is valid. Pulling the Hold (NHOLD) low locks the information on the data and address buses until released. This feature allows interfacing with slow peripheral devices. The timing diagram is shown in Fig. 1.

The microprocessor alone supports minimal I/O in the form of two sense inputs and three flag outputs. The sense inputs can generate interrupts (if enabled) and the flag outputs are latched. (In our system one flag and sense line are dedicated to the RS-232 port.) An internal oscillator will accommodate either a crystal or resistance-capacitance network. It is possible to construct a working system with only three devices—the microprocessor, a programmable random-access memory (RAM) chip and an erasable-programmable read-only memory (EPROM) chip containing the user program. The block diagram (Fig. 2) shows the interconnections for this system.

Upon power-up or reset the interpreter performs the following tasks:

- The size of RAM is determined.
- RAM is nondestructively tested.
- Variables and stacks are initialized.
- The data rate is established.
- A check for a program in ROM at 8000 (hexadecimal) is made. If one is present, program execution begins. Otherwise, the command mode is entered and the interpreter waits for user input.

Programs are entered directly into RAM via the RS-232 port. All characters are stored in memory as ASCII values, and thus no tedious code conversion is necessary while examining memory during debugging.

## The Language

A high-level language will be recognized as a boon to anyone who has fought through the hand assembly of object code or purchased a costly development system. One of the prices paid in using a high-level language is that of speed. Fortunately, most control applications do not require the fast execution speed of machine language. However, should the need arise, the LINK command will jump from BASIC to an object-code subroutine and re-

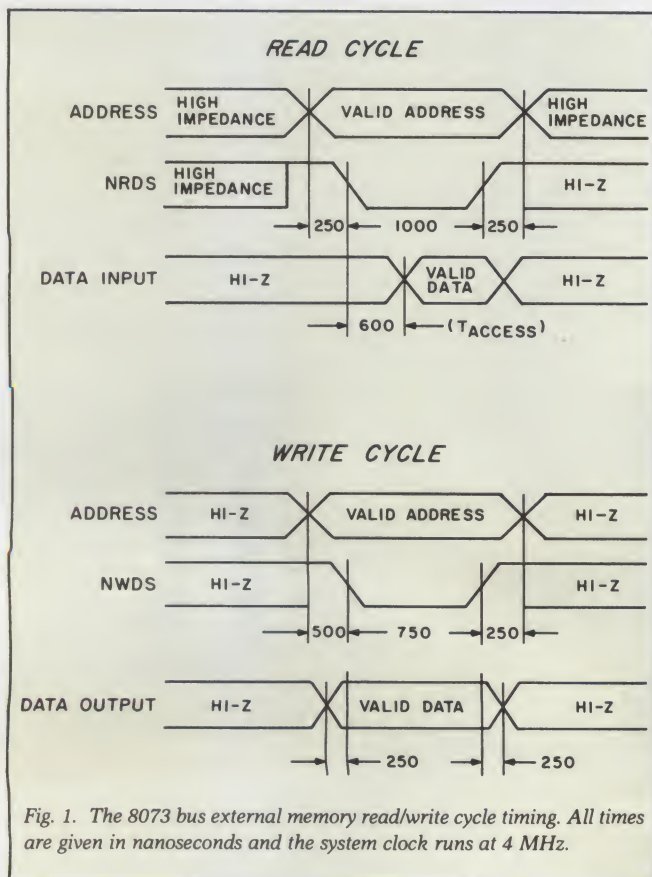


Fig. 1. The 8073 bus external memory read/write cycle timing. All times are given in nanoseconds and the system clock runs at 4 MHz.



turn. (The interpreter comes in handy when debugging machine-language programs.)

Another possible limitation of this BASIC is that of integer math. The two-byte format limits the integer-value range to  $\pm 32,767$ . In most instances this does not represent a serious constraint. By carefully scaling the data, the loss of resolution can be minimized; indeed, through more advanced programming, the problem may vanish.

The common BASIC statements supported include:

- **NEW**—sets the end of program pointer equal to the beginning address effectively erasing any program resident in RAM and signalling new program entry.
- **RUN**—runs the current program.
- **CONT**—continues execution at the point of suspension.
- **LIST <expression>**—lists the current program starting at line number (expression); default value is the first line number.
- **REM (Remark)**—skipped over during execution.
- **CLEAR**—initializes all variables and stacks; done automatically when a program is run.
- **LET**—optional.
- **PRINT <expression>**—prints value of <expression>. (Multiple outputs are separated by a comma. An ending semicolon suppresses the carriage return.)
- **IF/THEN**—THEN is optional.
- **FOR/NEXT . . . STEP**—STEP is optional.
- **DO/UNTIL**.
- **GOTO <expression>**—expression can be a number or variable.
- **GOSUB <expression> / RETURN**—expression same as GOTO.
- **INPUT**—inputs can be a number or a string.
- **DELAY <expression>**—delays up to 1040 ms in steps of 1 ms.
- **LINK <expression>**—executes machine-language routine beginning at memory location (expression).
- **TOP**—returns the next available RAM address.
- **MOD <a,b>**—returns the remainder of a/b.
- **RND <a,b>**—returns a random number between a and b inclusively.

In addition to these standard statements NSC Tiny BASIC has the following enhancements.

- **ON <expression>**—causes vectored interrupts from the sense inputs—the statement ON 2,200 causes a jump to line 200 when sense B (pin 39) goes low.
- **NEW <address>**—initializes pointer to a BASIC program without destroying any other program; thus, several different programs may reside in memory (RAM and/or EPROM) at once.
- **STAT**—allows examination and modification of the status register.
- **@<expression>**—a shorthand version of PEEK and POKE.
- @2000=67**—puts 67 at address 2000.
- A=@1200**—gives variable A the value at address 1200.
- Let @3000=@4000**—copies contents of address 3000 into address 4000.
- **INC <X>, DEC <X>**—these are used in multiprocessing applications (see National's literature).

Four arithmetic, six relational and three logical operators are recognized:

- **+, -, \*, /** add, subtract, multiply and divide
- **<, =, >, >=, <=** less than, less than or equal to, greater than or equal to, and greater than or equal to, and equal to
- **< >, =** not equal to, equal to
- **AND, OR, NOT** logical and, or, not

The capacity for string handling enhances the versatility of the interpreter. Strings are stored in ASCII starting at the address contained in the variable named. The statement **A=9000** tells the interpreter to store \$A in memory beginning at location 9000. Thus:

**>A=9000 : \$A="NSC TINY BASIC" : PRINT A,\$A**

will produce 9000 NSC TINY BASIC. A string move statement is supported, allowing very fast reading from or writing to peripheral devices.

The error codes of the 8073 are a substantial improvement over the "HOW" and "WHAT" of the early interpreters. (See Fig. 3.)

## The Hardware

The circuit was reduced to simplest form without compromising function. We set the size and capabilities of the system to match most of the applications we had seen. More than 150 lines of BASIC text can be stored in 4K bytes of EPROM. The 4K of available RAM might be used for program development while only 2K might be used for an operating system. Even the slowest EPROM and RAM chips have more than adequate timing margins. (The Toshiba 2016, Hitachi 6116, T.I. 4016, Mostek 4802 and others all work well.)

The system has the following features:

- Up to 4K bytes of RAM in 2K increments.
- Up to 4K of EPROM in 2K increments.
- Up to 8K of external RAM and/or EPROM.
- Addresses up to 2000 peripheral devices.
- A resident EPROM programmer.
- +5 V operation (EPROM programmer requires +25 V).
- 27 programmable I/O ports.
- A peripheral device select line.
- Serial I/O port—110, 300, 1200 and 4800 bits per second (bps).

The design of a microprocessor hardware system usually begins with the assignment of a memory location to each of the various components of the system (see Fig. 4). This is known as memory mapping. The interpreter expects to find data rate information at memory address FD00 (hexadecimal) and the auto-run EPROM at 8000, and it begins the RAM search at 1000. The second RAM must then be at 1800 while the second EPROM must be

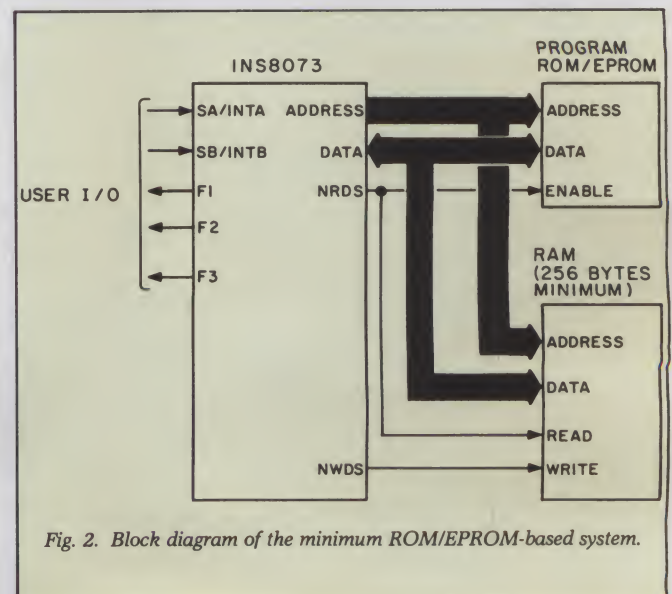


Fig. 2. Block diagram of the minimum ROM/EPROM-based system.



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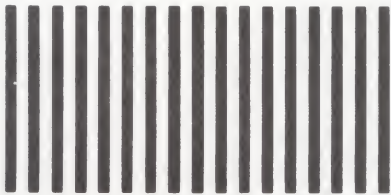
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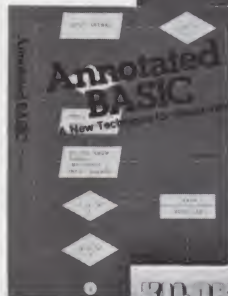
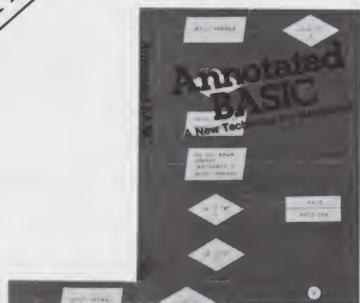
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at 8800 for continuous memory. The internal BASIC interpreter is located at 0000, and the internal RAM is mapped at FFC0.

These addresses set the decoding scheme. The remaining decoder outputs map the programmable interface at 0A00 and the peripheral function select at 9800 (2000 addresses). The 4000-7FFF block of code is an "image" of the C000-FFBF data rate address and cannot be used. This leaves 2000-3FFF free for external decoding, if desired (8000 addresses).

## Circuit Description

The 8073 requires few external components. The self-contained crystal oscillator is buffered to drive four low-power Schottky transistor-transistor logic (LSTTL) loads. While the oscillator will operate over a range of 100 kHz to 4 MHz, the 4 MHz used in this system is necessary for accurate data rates. The data and address lines will drive four LSTTL loads.

The RS-232 input circuit operates over a  $\pm 3$  V to  $+12$  V range. Q1 acts as a threshold detector and inverter. The output stage (Q2) swings from about  $-4.5$  V to  $+5$  V, which exceeds the minimum RS-232 specs. The  $-5$  V for the output stage is supplied by the voltage converter, U11. R3 and C7 form a power-up reset for the processor. This line is buffered and inverted for the 8255 and external devices.

Since the pin-outs of the 2K by eight-bit RAMs and EPROMs are the same, the devices are interchangeable in the RUN mode. If your operating system requires only one RAM chip and you want to save a little money, a 1K by eight-bit RAM like the 4118 could be used for U1. (Caution: You can't use a 1K RAM while developing programs because the interpreter expects 2K.)

The data rate is set by tying U9 to P12 and U9 to P14 high or low. The processor wait or hold line (NHOLD) is activated either by the EPROM programmer or an external input (active low) through U10. (See Fig. 5.)

The 8225, U5, programmable peripheral interface chip has 24 I/O lines that can be individually software configured as either an input or output so that no external hardware is needed. The chip has three operating modes, but the description is too detailed to discuss in this article. We will briefly cover mode 0, the most common, and suggest that those who are interested in the remaining modes consult the data sheet.

The device is divided into three ports: (A) PA0 to PA7,

Error code	Explanation
1	Out of memory
2	Statement used improperly
3	Unexpected character (after legal statement)
4	Syntax error
5	Value (format) error
6	Ending quote missing from string
7	GO target line does not exist
8	RETURN without previous GOSUB
9	Expression, FOR-NEXT, DO-UNTIL or GOSUB nested too deeply
10	NEXT without previous matching FOR
11	UNTIL without previous DO
12	Division by zero

Fig. 3. The 8073 error codes.

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(B) PB0 to PB7 and (C) PC0 to PC7. The chip select line (U5 to P6) is mapped at 0A00 (hexadecimal) so that port A is addressed at 0A00, port B at 0A01 and port C at 0A02. An internal control register is mapped at 0A03. The control word determines the I/O configuration. For example, the control word 10 (hexadecimal) makes all lines inputs and the control word 9B makes them all outputs.

> @ #0A03=#10 REM MAKE THEM ALL INPUTS

> @ #0A03=#9B REM MAKE THEM ALL OUTPUTS

See the 8255 data sheet for the other combinations. Drive requirements in excess of about one TTL load will require external buffers. On power-up the 8255 initializes into the all-input mode.

The EPROM programmer is read at 8000 (hexadecimal) and written to at 9000. When you power-up or type NEW #8000, the interpreter determines whether that location

is RAM or ROM by saving the information at 8000 and trying to write a test number into 8000. If it is successful, it restores the previous byte and treats that location as RAM. If not, it concludes that ROM is at 8000. If you have your utility chip in that socket and your +25 V programming supply is on, it will write over the first byte rendering your utility chip useless. Thus, placing the programmer at 9000 minimizes this type of error.

When writing to 9000 through 97FF with the +25 V programming supply connected, data will be programmed into U4. The decoded address (U8 to P9) and the write (NWDS) are applied to pins 2 and 3 of U2. The output goes high triggering the 50 ms one-shot, U7. The output (U7 to P6) drives the NHOLD line (U6 to P5) low via U10. This locks both the address and data buses in their present state until the one-shot output goes low.

```

OPR"SYS-1A *OCTAGON SYSTEMS CORP* (C) 8/81"
1S=@#FFD9*256+#E8:T=S+20:U=@#FFD5*256:$S="-----":PR"":PR"Select"
2PR$S:PR"<1> MOVE BASIC PROGRAM"
3PR"<2> COPY MEMORY"
4PR"<3> HEX DUMP"
5PR"<4> DEC/HEX CONVERT"
6PR"<5> LLIST SERIAL"
7INPUTI:PR"":GOTOI*10*(I>0)*(I<6)
8Y=@(J+I):IF(Y=127)OR(Y>57)OR(Y<49)X=0
9RETURN
10PR$(U+#77):PR"SOURCE":GOSUB80:GOSUB81:INPUTJ:IFJ=0GOTO1
11J=J-#10FF*(J=1)-#7FFE*(J=2):V=#1100:W=#8000:X=#9000:Z=#9800
12IF(J<V)OR((J>S)AND(J<W))OR(J>X)PR"*NO SOURCE":GOTO10
13PR"DESTINATION":GOSUB81:INPUTK:K=K-#10FF*(K=1)-#8FFE*(K=2)
14IF((K<V)AND(K>=0))OR((K>S)AND(K<X))OR((K>=Z)AND(K<0))PR"*NO DEST":GOTO13
15L=0:IF(J=V)AND(@TOP-1)=127)L=TOP-V-1
16I=0:IFK<0GOSUB82:GOTO19
17$(K+I)=$(J+I):PR$(K+I):DO:I=I+1:UNTIL@J+I=13:I=I+1:GOSUB8:IFX<>0GOTO17
19@J+I=127:GOSUB90:GOTO1
20PR$(U+#93):GOSUB80:PR"destination":INPUTK:IFK=0GOTO1
21PR"source start":INPUTJ:PR"source end":INPUTL
25DO:@K=@J:K=K+1:J=J+1:UNTILJ>L:GOTO1
30PR$(U+#A8):GOSUB80:PR"start at":INPUTJ:IFJ=0GOTO1
33FORI=JTOJ+255STEP16:N=@#1011:GOSUB70:N=@#1010:GOSUB70:PR" ";
35$S=".....":FORK=0TO15:L=I+K:N=@L:GOSUB70:PR" ";
36IF(N>31)AND(N<127)@S+K=N
37NEXTK:PR" ", $S:NEXTI:GOTO30
40PR$(U+#BA):GOSUB80
41PR"":PR"dec=":INPUTD:N=@#1007:GOSUB70:N=@#1006:GOSUB70:IFD=0GOTO1
42GOTO41
50PR$(U+#D2),"source":INPUTJ:PR"printer on":INPUT$T
51PR$J:DO:J=J+1:UNTIL@J=13:J=J+1:DELAY200:IF@J<>127GOTO51
52 PR"print OFF":INPUT$T:GOTO1
70$T="00":@T+1=MOD(N,16)+48:@T=N/16+48:@T=@T-(@T>57)*7
71@T+1=@T+1-(@T+1>57)*7:PR$T:RETURN
80PR"<0> EXIT TO MENU":RETURN
81PR"<1> RAM (#1100)":PR"<2> EPROM":PR"<address> OTHER":RETURN
82PR"length=":IFL=0L=J:DO:L=L+1:UNTIL@L=127:L=L-J
83PRL+1,"bytes":IFL>2047PR"*NO FIT <cont>":STOP
84PR"Turn on +25V":INPUT$T
85$(K+I)=$(J+I):PR$(K+I-4096):IF@K+I-4096<>@J+I)PR"*BAD BIT":STOP
86DO:I=I+1:UNTIL@J+I=13:I=I+1:GOSUB8:IFX<>0GOTO85
87PR"turn OFF 25V":INPUT$T:RETURN
90PR"":PR$(U+#65):PR$S:GOSUB80:PR"<1> go to dest":INPUTH:IFH<>1RETURN
91@#FFD4=@#1014:@#FFD5=@#1015
92I=I+K:IFK>0@#FFD6=@#1010:@#FFD7=@#1011

```

Listing 1. Utility programs for our 8073 system are Dump, Move, Copy Memory, Dec/Hex and LList.



The microprocessor actually halts during this interval.

## Programming the System

Generally speaking, this system programs like bigger computers. National Semiconductor has two publications that contain detailed information on the language. Using *NSC Tiny BASIC* is a 20-page summary of the language which will be adequate for anyone who has had previous programming experience. The *NSC Tiny BASIC User's Manual* is much more detailed, with some programmed instruction. The presentation is somewhat uneven, and there are a few minor errors, but it would be excellent for those who have never programmed in any high-level language. It is not possible to cover the language in detail in this article, but we can offer some hints and information that will help in programming:

- Program lines may contain multiple statements separated by a colon.

- Maximum line length is 72 characters.

- A string is any sequence of numbers or ASCII characters terminated with a carriage return. There is no limit to the length of a string.

- Each statement is stored literally, not as a single-byte token. For example, PRINT requires five memory locations.

- Including the optional LET will speed program execution.

- Multiple statements on a line generally speed execution.

- Use parentheses in complicated arithmetic expressions.

- Memory can be saved (although it's cheap these days) by leaving out optional words, remarks and extra spaces, and by using more than one statement per line.

- The break key will stop normal program execution. Control-C must be used to break an INPUT statement.

- More than one program may reside in RAM at one time but only the current program may be modified. How-

Location (Hexadecimal)	Function
0000-09FF	BASIC interpreter ROM
0A00-0FFF	Programmable Interface
1000-17FF	First 2K of RAM
1800-1FFF	Second 2K of RAM
2000-3FFF	Unused
4000-7FFF	Data Rate Select
8000-87FF	First 2K of EPROM
8800-8FFF	Second 2K of EPROM
9000-9800	EPROM programmer
9800-9FFF	Peripheral Device Select
A000-BFFF	Unused
C000-FFBF	Data Rate Select
FFC0-FFFF	Internal 64 bytes of RAM

Fig. 4. Memory map indicating the memory locations of the various components of the system.

Data Rate	D1	D2
110	H	H
300	L	H
1200	H	L
4800	L	L

Fig. 5. These data rates achieved by four combinations of high/low inputs.

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- Instructions include programming examples.

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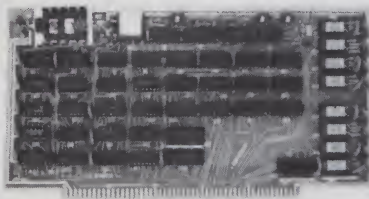
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ever, the others may be listed and run.

- Pushing the reset button does not destroy the contents of RAM or your program but it does destroy the program pointers. You can still run or list the program but you can't modify it without changing the pointers.

- The interpreter accepts only uppercase characters but it can print both upper and lowercase.

- The first statement of an auto-run EPROM must be CLEAR.

To begin writing a program, you must give the computer a beginning address. The interpreter allocates the first 256 bytes of RAM. Since RAM starts at 1000 (hexadecimal) the first available location for the user is 1100. Any higher RAM address may also be used. This BASIC uses the # symbol to designate a hexadecimal number. Thus you enter:

>NEW#1100

You now tell the computer that you want to start a new program:

>NEW

The interpreter writes an end-of-program marker (127) into 1100, effectively erasing the previous program as far as the interpreter is concerned. The interpreter is now ready to begin entering your program into RAM.

## System Utility Library

Utility programs can provide the user with handy software to aid in developing, debugging and storing programs. Most utilities for small systems (and many large systems) include an abbreviated notation that must be referred to if the utility is not often used. A menu-driven utility with prompting in everyday English significantly reduces the hassle. Our routines have as many error-catching features as memory would allow (2048 bytes are used). A very brief overview of the utilities (given in Listing 1) follows:

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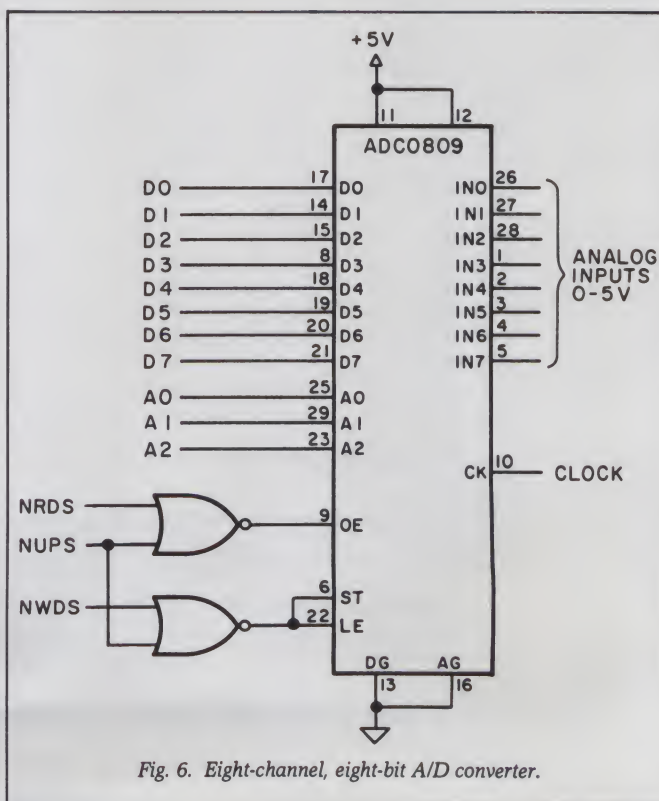


Fig. 6. Eight-channel, eight-bit A/D converter.



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●DUMP—Prints lines of memory in hexadecimal and ASCII.

●MOVE PROGRAM—Block-moves a BASIC program from EPROM or RAM to another RAM location.

●COPY MEMORY—Copies any block of code from one part of memory to another.

Either the MOVE or COPY command may be used to program an EPROM. The destination address is 9000, the EPROM programmer.

●DEC/HEX—Converts any decimal number 0–32767 to its hexadecimal equivalent. (A hex/dec converter is built into the interpreter.)

●LLIST—Sends the program text to a serial printer.

You can enter this software into RAM, test it and, using its own EPROM routines, program a 2716 EPROM. Place the EPROM in the socket at U4, type <NEW #8800> and you are off. The prompting makes each routine self-explanatory.

### System Applications

To program the system, you will need to communicate through the RS-232 port. This can be done with nearly any dumb terminal, a computer with a similar port, or one of the \$150 terminal kits and your TV set. The interpreter accepts only uppercase characters and operates in the full duplex mode.

Before you can run, you must set the data rate. The data rate is programmed by strapping the inputs (P12, 14) of U9 either low or high. A data rate of 4800 bps is the usual choice for terminals. A pull-up resistor keeps D7 high during the data rate read time. (Fig. 5 lists the four combinations.)

The next step is to set the pulse width of the EPROM programmer. Make sure that the socket at U4 is empty and place a scope probe on U7 to P6. Now enter the following program:

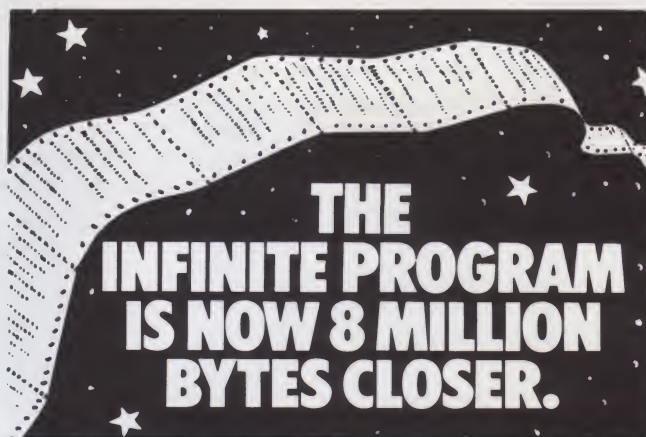
```
>NEW #1100
>NEW
>10 @ #9000 = 255 : GOTO 10
>RUN
```

Adjust the 20k potentiometer until the pulse width (positive) is just 50 ms. When properly adjusted, about 16 pulses per second will be seen. Setting it more than 55 ms may damage EPROMs and less than 45 ms may result in incomplete programming.

Hard copy of your programs can be printed by a low-cost serial printer or the 8255 can be programmed to handle a Centronics or similar parallel interface. We use Epson MX-70 printers in our systems with software written in machine language to get the maximum printing speed. The BASIC interpreter was an invaluable aid in writing that software. Once the program is written, debugged and committed to EPROM, the terminal does not need to be used. For example, a simple security system might have only switch inputs, and indicator and alarm outputs.

A common need for both industrial and home applications is analog-to-digital (A/D) conversion. An ideal chip for this system is the ADC0809 (National and Texas Instruments), which is an eight-channel, eight-bit converter with a 0 to +5 V input range. The clock signal can be divided down from pin 7 of the 8073 oscillator or it can be a simple two-gate oscillator. The interface for this chip is shown in Fig. 6.

This 50-cent interface illustrates the simplicity of the bus structure. The software is also uncomplicated. A/D conversion is started by writing to the channel number



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you want. Since the 100  $\mu$ s conversion time of the ADC0809 is faster than the command interpretation, you can read out the data in the same program line. The one-line program below prints out A/D channel 0 as fast as the interpreter can execute the instructions (about 35 conversions and printouts per second). The 0 is arbitrary and could be any number. (The software examples have extra spaces for clarity and include helpful remarks. These could be omitted in an actual program.)

```
>10 @#9800=0 : PRINT @#9800 : GOTO10
```

A program to convert and print out all eight channels is still relatively simple:

```
>10 FOR X=0 TO 7 :REM SCAN ALL 8 CHANNELS
>20 @(#9800+X)=0 :REM CONVERT
>30 PRINT @(#9800+X); :REM PRINT IT
>40 NEXTX : PRINT "" : GOTO10 :REM DO IT AGAIN
```

The trailing semicolon in line 30 suppresses the carriage return so that all eight channels are printed on one line. The statement PRINT "" performs a carriage return and line feed. Despite using about twice as much code as the first example, the speed is still more than 25 conversions per second (joystick heaven!).

Here in Colorado, we're facing another large energy cost increase this winter. More homeowners are considering energy-saving devices, such as automatic setback thermostats. Using a computer system for this task has several advantages over electromechanical devices. You can have as many different cycles as you need without increasing the cost. It can easily control other energy-saving devices. It has the power and flexibility to simultaneously perform other tasks, such as home security.

In our state, 45 percent of the cost of a setback thermostat is deductible from income taxes (30 percent state, 15 percent federal). Fig. 7 shows a possible application. The

key to this circuit is a National MM58174 real-time clock which counts seconds, minutes, hours and dates. You can access any of these counters separately. Other real-time clock chips could also be used.

A thermistor connected to the A/D converter can be placed near your present thermostat. One output of the 8255 drives a small relay that controls the off/on cycles of the furnace.

Also shown is a peak demand controller that could be used both in home and industrial environments. In most localities, the power company will sell electricity at a reduced rate if your usage is below a certain peak value. Say that you have an electric home with the heat on in all rooms. When you turn on the electric dryer, the line current exceeds the peak limit. Your computer system could temporarily shut down the heat in the laundry room to compensate. The scheme measures the total ac current, detects when the peak has been exceeded and goes to a lookup table to determine what to shut down. Using a real-time clock, the table could vary according to the time of day. It's easy to see that tuning up the system is so much easier by changing the software rather than hardware.

Other inputs and outputs can handle the security system. Even in this simple application, the computer system is less expensive than the assortment of components needed to do the same task. It's convenient to be able to quickly step through the program to check the external hardware.

Industrial users often need to prompt operators. This has usually been done with back-lighted buttons or numeric displays. There are now a number of alphanumeric displays that readily interface with computers. The major advantage of alphanumeric is that all the messages may be completely spelled out and require only a few minutes on the keyboard to change. This feature

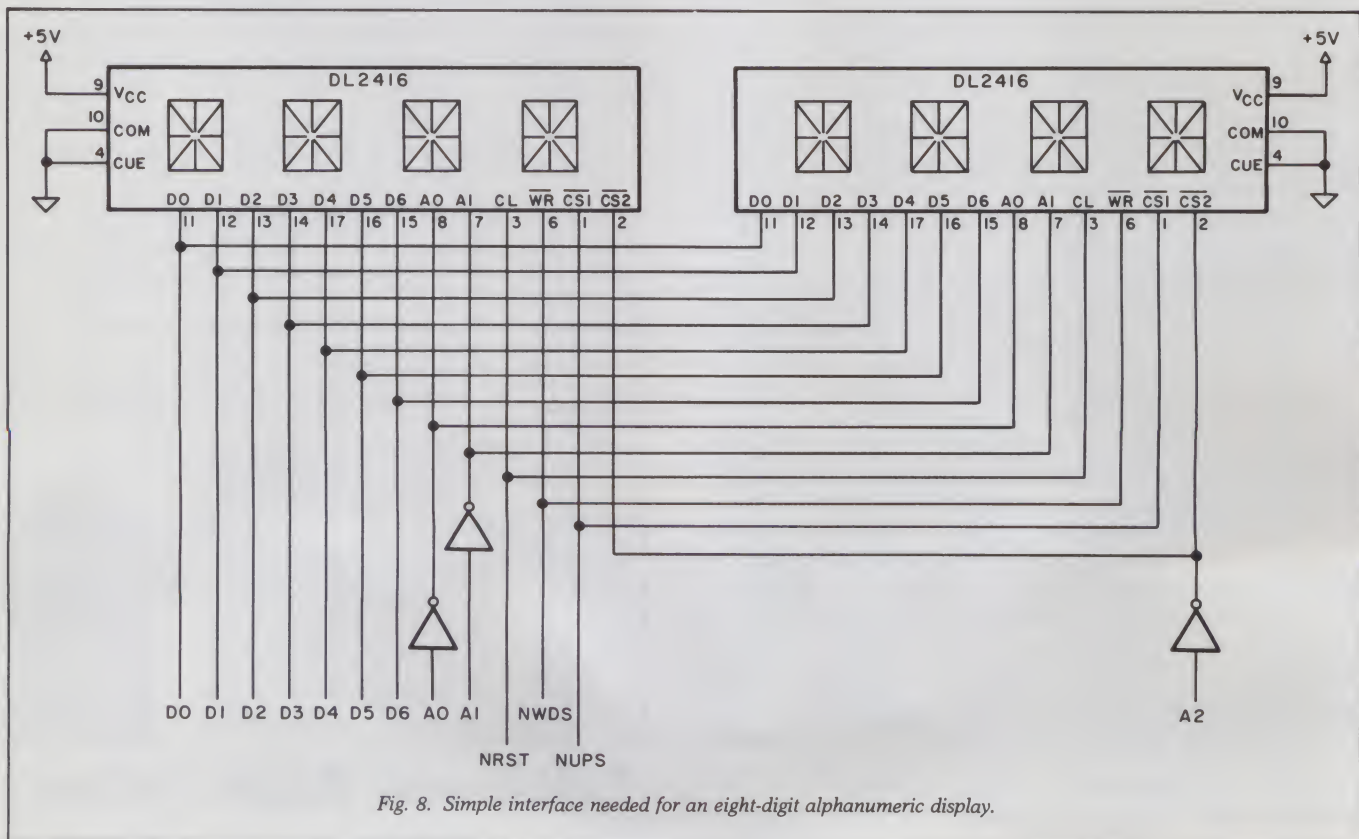


Fig. 8. Simple interface needed for an eight-digit alphanumeric display.



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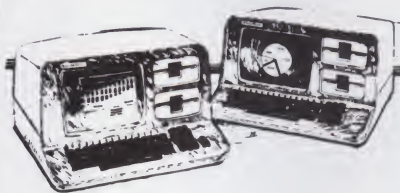
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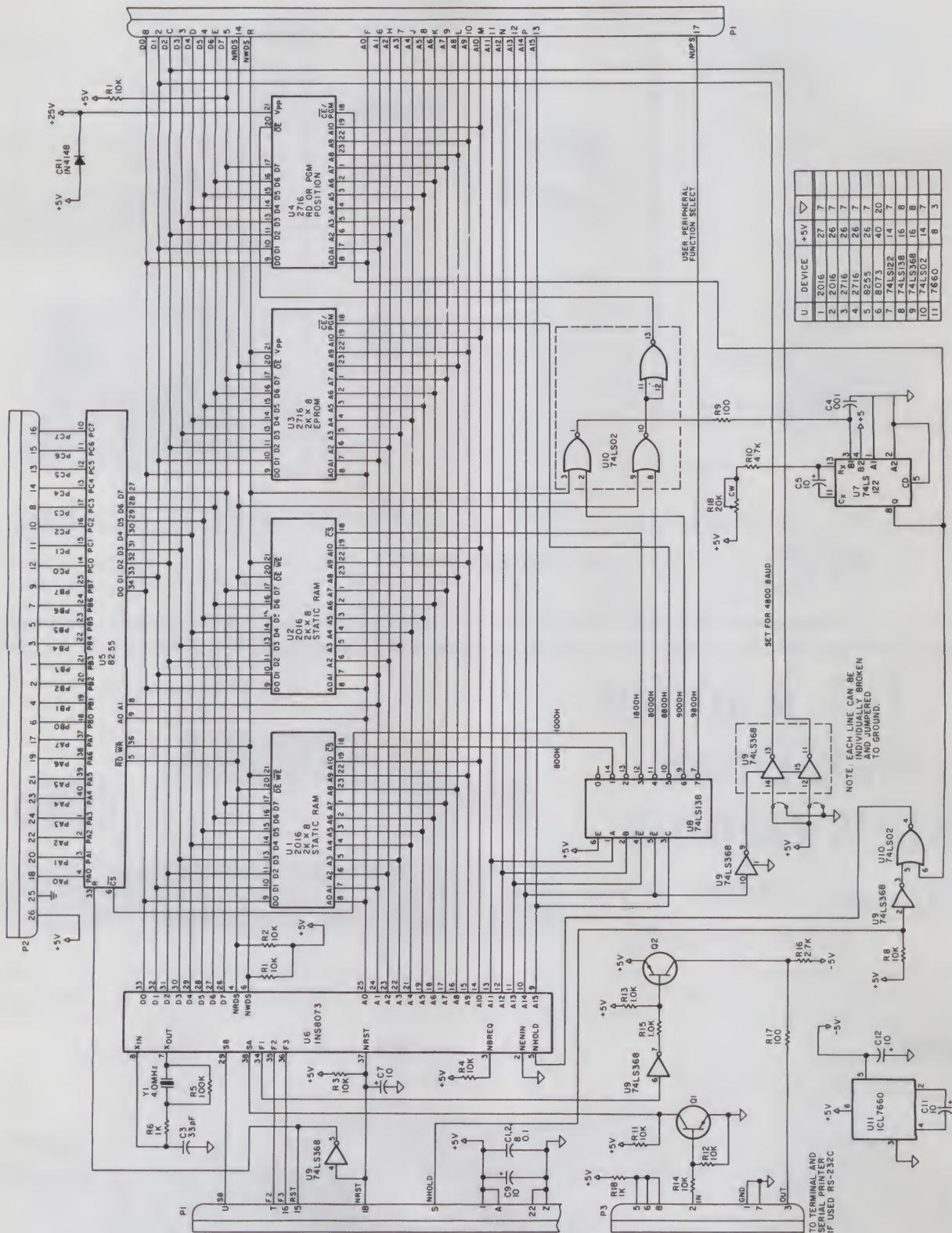


Fig. 9. Schematic of the 8073 system.



eliminates costly and time-consuming hardware modification. The interface for the Litronix DL-1416 or DL-2416 four-digit display is almost trivial. This is due in part to the fact that latching, decoding and character generation are built into the chip. Only three inverters are needed for eight digits of alphanumeric display. (See Fig. 8.)

Note that the address lines A0 and A1 are inverted to make the left-most digit 9800 (hexadecimal) and the right-most digit 9807. You can display information in several ways. For example, running the program below will illustrate the blazing speed of a string move and allow you to enter your own messages.

```
>10 B=#9800 :REM DISPLAY ADDRESS
>20 INPUT $B :REM GET $B AND DISPLAY IT
>30 GOTO 20 :REM DO IT AGAIN
```

ASCII characters can also be directly poked into any of the eight locations using the @<expression>=ASCII statement.

### Conclusion

The system we have just described is a powerful and flexible microprocessor system. The choice of CPU and careful circuit design has yielded a system that can be understood by those with different levels of electronics background. Because it uses the BASIC language, even those who have no formal training in electronics can program the system. The basic system has sufficient I/O to meet the needs of most small controllers and can be expanded to control literally hundreds of external devices. The user can write programs, debug them and commit them to nonvolatile memory while sitting at his desk. Programming takes one-tenth the time of assembly-language programming at a cost of less than one-tenth of a development system. The system's low cost will make it useful for home as well as industrial applications. ■

### Other Applications

We have done a number of things not described in the article with our 8073 system. These involve the following:

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The computer in this article is available as a kit (\$175). The kit includes all components, screened and solder-masked PC board, 2K bytes of RAM, a 2716 programmed with utility library and 150 pages of documentation (\$25, separately). Octagon Systems Corp., 2849 West 35th Ave., Denver, CO 80211. (303-458-1705).

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74LS30	.25	74LS163	.90	74LS363	1.35
74LS32	.35	74LS164	.90	74LS365	.90
74LS35	.55	74LS165	.90	74LS366	.90
74LS37	.50	74LS166	2.00	74LS367	.65
74LS38	.35	74LS168	1.70	74LS368	.65
74LS40	.25	74LS169	1.70	74LS373	1.15
74LS42	.50	74LS170	1.70	74LS374	1.75
74LS47	.75	74LS173	.75	74LS375	.65
74LS48	.75	74LS174	.90	74LS377	1.40
74LS49	.75	74LS175	.90	74LS385	1.85
74LS51	.25	74LS181	2.10	74LS386	.60
74LS54	.35	74LS189	9.95	74LS390	1.85
74LS55	.35	74LS190	.95	74LS393	1.85
74LS63	1.20	74LS191	.95	74LS395	1.60
74LS73	.35	74LS192	.80	74LS399	1.65
74LS74	.40	74LS193	.90	74LS424	2.95
74LS75	.50	74LS194	.95	74LS447	.35
74LS76	.40	74LS195	.90	74LS490	1.90
74LS78	.50	74LS196	.80	74LS630	75.00
74LS83	.75	74LS197	.80	74LS640	3.00
74LS85	1.10	74LS221	1.15	74LS641	3.00
74LS86	.40	74LS240	1.15	74LS642	3.00
74LS90	.60	74LS241	1.15	74LS645	3.00
74LS91	.80	74LS242	1.85	74LS668	1.65
74LS92	.65	74LS243	1.85	74LS669	1.85
74LS93	.60	74LS244	1.00	74LS670	2.15
74LS95	.80	74LS245	1.95	74LS674	9.60
74LS96	.80	74LS247	.75	74LS682	3.15
74LS107	.40	74LS248	1.20	74LS683	2.25
74LS109	.40	74LS249	.95	74LS684	2.35
74LS112	.40	74LS251	1.25	74LS685	2.35
74LS113	.40	74LS253	.80	74LS688	2.35
74LS114	.50	74LS257	.80	74LS689	2.35
74LS122	.45	74LS258	.80		

## 74S00

74S00	.40	74S163	3.70
74S02	.45	74S168	4.60
74S03	.45	74S169	5.40
74S04	.75	74S174	1.05
74S05	.75	74S175	1.05
74S08	.45	74S181	4.45
74S09	.75	74S182	2.90
74S10	.65	74S188	3.90
74S11	.80	74S189	14.90
74S15	.65	74S194	2.90
74S20	.65	74S195	1.85
74S22	.75	74S196	4.85
74S30	.45	74S197	4.20
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74S64	.75	74S253	7.40
74S65	1.20	74S257	1.35
74S74	.65	74S258	1.45
74S85	2.35	74S260	1.80
74S86	1.40	74S274	19.90
74S112	1.55	74S275	19.90
74S113	1.95	74S280	2.85
74S114	1.45	74S287	4.70
74S124	2.75	74S288	4.40
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74S157	1.15	74S474	17.80
74S158	1.40	74S482	15.50
74S161	2.80	74S570	7.75
74S162	3.70	74S572	7.75

## 74C00 CMOS

74C00	.35	74C195	2.20
74C02	.35	74C221	2.20
74C04	.35	74C240	2.20
74C08	.35	74C244	2.20
74C10	.35	74C373	2.70
74C14	1.45	74C374	2.70
74C20	.35	74C901	.80
74C30	.35	74C902	.80
74C32	.50	74C903	.80
74C42	1.70	74C904	.80
74C48	2.05	74C905	10.90
74C73	.65	74C906	.90
74C74	.85	74C907	.90
74C76	1.90	74C908	2.00
74C83	1.90	74C909	2.70
74C86	.90	74C910	9.90
74C89	4.50	74C911	9.90
74C90	1.70	74C912	9.90
74C93	1.70	74C914	1.90
74C95	1.70	74C915	1.90
74C107	.95	74C917	2.70
74C150	5.70	74C918	1.90
74C151	2.20	74C920	16.00
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4002	.35	4042	.75	4503	.65
4006	.95	4043	.85	4505	8.95
4007	.35	4044	.85	4506	1.25
4008	.95	4046	.95	4507	.95
4009	.45	4047	.95	4508	1.95
4010	.45	4048	.75	4510	.95
4011	.35	4049	.55	4511	.95
4012	.35	4050	.55	4512	.95
4013	.45	4051	.95	4514	2.25
4014	.95	4052	.95	4515	2.25
4015	.95	4053	.95	4516	1.50
4016	.45	4055	2.75	4518	1.25
4017	.95	4056	2.75	4519	1.25
4018	.95	4059	9.95	4520	1.25
4019	.45	4060	1.25	4522	1.25
4020	.95	4066	.75	4526	1.25
4021	.95	4068	.40	4527	1.75
4022	.95	4069	.40	4528	1.25
4023	.35	4070	.40	4531	.95
4024	.75	4071	.30	4532	1.75
4025	.35	4072	.30	4539	1.75
4026	1.95	4073	.30	4543	1.95
4027	.65	4075	.30	4553	4.95
4028	.80	4076	.95	4555	.95
4029	.95	4078	.50	4556	.95
4030	.45	4081	.40	4558	2.25
4031	1.50	4082	.40	4568	5.95
4032	2.75	4085	.95	4581	1.95
4033	2.75	4086	.95	4582	1.95
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4035	.85	4094	3.95	4585	.95
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7805CT	.85	LM301V	.75	LM567V	1.25
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		LM317T	1.90	LM747	.75
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7915CT	1.15	LM380	1.25	LM3909	.90
		LM386V	1.25	LM3914	3.75
				LM3915	3.75
7905K	1.50	LM555V	.40	LM3916	3.75
7912K	1.50	LM556	.70	DS75451	.40
79L05	.75	LM565	.95	DS75452	.40
79L12	.75	LM566V	1.50	DS75453	.40
79L15	.75				

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# Popping and Pushing Permutations in BASIC

By Kenneth Wasserman

A permutation of a sequence of objects is a rearrangement of their order. Occasionally, when writing a program, one needs to compute all possible permutations of a group of objects. Most people with some mathematical background will know that given  $N$  objects there will be  $N!$  (read as  $N$  factorial, representing the product  $N \times (N-1) \times (N-2) \times \dots \times 2 \times 1$ ) ways of permuting a given sequence. However, when it comes to explicitly listing all these  $N!$  sequences, people are often hard-pressed to come up with a general algorithm.

## Some Motivation

Why, you might ask, would anyone want an exhaustive list of all possible arrangements of a series of objects? Edward Rager, in his article entitled "Scramble" (*Microcomputing*, January 1981, p.78), provides a program to assist the user in solving anagram puzzles, words or phrases whose letter or word positions have been rearranged to mask their true spelling or meaning. He suggests that his program is of great help in unscrambling such puzzles often presented in the game sections of newspapers. His program will output all possible letter permutations of any word given as input, providing that the word has either three, four, five or six letters. The restrictions on word length arise because each word length is treated by a separate subroutine in BASIC.

To handle the four cases of different-length words, Rager needs to use about 80 BASIC statements, not counting input, output or remarks.

This article will present a more general algorithm that uses only seven BASIC statements.

Rager's general strategy is to use brute force in listing all permutations of three-letter words, and to use this subroutine as the *kernel* for longer words. That is, a four-letter word is handled by removing the first letter and permuting the remaining three by use of the "brute force" subroutine. Then the second letter is removed, and the new group of the three remaining letters is permuted. Next the third letter is held back, and again the three-permutation is done. Finally, the last letter is removed, and the first three letters of the original word are permuted.

At each stage the letter held back is concatenated to the front of each three-letter permutation before it is printed. Words five letters long are treated in a similar manner, except that the routine just described for four permutations is called after each one of the initial five letters is removed. Again, the letter is first stuck onto the front of the four-permutation before it is printed. Six-letter words are similarly permuted.

## An Elegant Solution

The basic concept embodied in Scramble is central to the functioning

of a recursive program; that is, the solution to a problem by the use of a program segment which calls itself as a subroutine. To avoid a seemingly infinite number of subroutine calls, a recursive program usually has a conditional statement that checks to see if some base level has been reached. If this base level is reached, then a return from a subroutine statement is executed, avoiding an infinite recursion.

In Scramble, this base level is a word that is three letters long. However, this program is not recursive in that each different-length word is initially handled by a separate subroutine; thus, no part of the program calls itself as a subroutine.

Unfortunately, the BASIC language does not allow truly recursive subroutines. This stems from the fact that all variables are global; that is, they are known to all parts of the program at all times. A recursive subroutine should allow for local variables known only within the subroutine and known only at one particular level in the recursion. The concept of a level of recursion is very useful if one wants to simulate a recursive routine in BASIC. To understand the idea of a level of recursion, as applied to the permutation problem, you can think of the length of the word that is

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being permuted as the level of recursion.

For example, if you wanted to use a recursive procedure to find all permutations of the word CAT, you would start at level 3. You would remove each letter and call the permutation procedure with the "words" AT, CT and CA. Each of these two-letter words would be processed at level 2 in the procedure. In level 2 you would call the permutation subroutine at level 1 with the word A and then with T for the word AT. You would do a similar call with C, T and C, A for the words CT and CA, respectively. Finally, in level 1 each word would simply cause a return of itself. Level 1 is the base level so that it defines the enumeration of permutations of a one-letter word as only that single letter.

After reaching level 1, the procedure pops back up to level 2, where the letter that was removed is concatenated onto the front of the word. The second letter of the word at level 2 is then removed and you push down to level 1, which then pops back up to level 2, where the removed letter is stuck onto the front of the single-letter word. Having finished both letters of the word at level 2, the procedure pops up to level 3 and proceeds with processing the next letter of the three-letter word, CAT. When all processing is complete at level 3, it finally pops back up to the main program, which called the permutation procedure in the first place.

All this pushing and popping suggests that a pushdown stack is a good way to implement recursive routines. Stacks are easy to handle in BASIC, and are thus what I will use to write this recursive routine. A stack is most easily implemented with a one-dimensional array and a stack pointer or simply an index into the array. Thus, if you call the stack I and the stack pointer L, you can locate the next stack entry by I(L). To add an entry on the stack you use  $L = L + 1$ , then  $I(L) = \text{entry}$ . To remove an entry you use  $\text{entry} = I(L)$  and assign  $L = L - 1$ .

### How to Do It

You are now ready to describe permutations, a simple routine in BASIC for enumerating all possible permutations of a given word of unrestricted length. This program was written in PET BASIC and works equally well on an Apple or TRS-80 (see Program listing). Lines 1000 through 1060 contain the permutation sub-

routine that does all the work.

Only three variables are used by the subroutine. The variable L serves a dual purpose; it indicates the level of recursion as well as the length of the word at that level. I(L) is the pushdown stack (described above) used to indicate what letter, at the current level of recursion, is to be removed from  $W\$(L)$ .  $W\$(L)$  is the word to be permuted at level L.  $W\%$  is a variable used to hold the top level word needed by the print subroutine at line 2000.

The subroutine must be called with L set equal to the length of the word you wish to permute and with  $W\%$  equal to  $W\$(L)$ , the word itself. Line 1000 checks to see if the base level of the recursion has been reached. If it has, the subroutine at line 2000 is called and the procedure pops back up to the next-higher level. Otherwise it sets up a FOR...NEXT type loop between lines 1010 and 1060.

The counter variable I(L) is initialized to L in line 1010. Line 1020 inserts the letter currently being removed at level L into the proper place in  $W\%$ . Line 1030 forms the word to be permuted at the next lower recursive level. The actual recursive subroutine call occurs in line 1040. Note that you must explicitly decrement and later increment the value of L, because all variables are global in BASIC and you need a way of keep-

ing track of the current level.

Lines 1050 and 1060 finish off the FOR...NEXT type loop by decrementing the loop counter, I(L), and checking for termination. If the loop at level L is finished, the procedure returns to the next higher level; otherwise it goes to line 1020 and removes the next letter.

The only operator used which might vary among versions of BASIC is the MID\$ function. When given three arguments, MID\$ will return the substring of the first argument starting at the position specified by the second argument with a length given by the third argument. However, when only two arguments are given to MID\$, it will return the substring of the first argument, starting at the position specified by the second argument and continuing until the end of the original string. If your version of BASIC does not have this feature, it should be easy enough to simulate using the LEN (length) function.

Hopefully, the user will find many other applications for this procedure and the techniques it uses. One possible application involves analyzing playing card hands for numerical sequences, as in poker or cribbage. All possible orderings can be generated and a simple check of each will determine if a beneficial sequence exists within the hand. ■

```
10 REM PERMUTATIONS BY KENNETH WASSERMAN 3/12/81
20 :
30 REM THIS PROGRAM WILL LIST ALL POSSIBLE PERMUTATIONS OF THE WORD GIVEN AS
40 REM INPUT. A RECURSIVE SUBROUTINE IN LINES 1000-1060 PRODUCES THE NEXT WORD
50 REM TO BE OUTPUT. THE SUBROUTINE IN LINES 2000-2050 CAN BE USED TO SIMPLY
60 REM PRINT THE REARRANGED WORD OR IT CAN BE EXTENDED TO REQUEST FURTHER
70 REM ANALYSIS ON THE WORD PRESENTED TO IT.
80 :
100 INPUT W$
110 L=LEN(W$)
120 DIM W$(L),I(L)
130 W$(L)=W$
140 GOSUB 1000
150 END
999 :
1000 IF L=0 THEN GOSUB 2000: RETURN
1010 I(L)=L
1020 W%=MID$(W$,1,L-1)+MID$(W$(L),I(L),1)+MID$(W$,L+1)
1030 W$(L-1)=MID$(W$(L),1,I(L)-1)+MID$(W$(L),I(L)+1)
1040 L=L-1: GOSUB 1000: L=L+1
1050 I(L)=I(L)-1: IF I(L)=0 THEN RETURN
1060 GOTO 1020
1999 :
2000 REM THIS SUBROUTINE IS PASSED A WORD IN THE VARIABLE W$. NOTE THAT W$
2010 REM IS A PERMUTATION OF THE ORIGINAL WORD INPUT TO THIS PROGRAM. ITS
2020 REM VALUE SHOULD NOT BE CHANGED BY THIS SUBROUTINE.
2030 :
2040 PRINT W$,
2050 RETURN
```

*Program listing. The Permutations program was written in BASIC on a Commodore PET, but it will run "as is" on an Apple II with Applesoft. It will also run on a TRS-80 with Level II BASIC if you add the following line:*

*90 CLEAR 1000*

*If you want to check the permutations of a ten-letter word, plan on spending a few days in front of your computer's display—there are 3,628,800 permutations to watch.*



---

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# The Secret World Of the Superbrain

By Lawrence J. Bregoli

**W**hen I started in 1976 as a hardware hacker, I never thought I would own a machine as powerful as the Superbrain. In those days 1K bytes of 2102 RAM and a hex display were all that anyone could ask for. Today I can pick up a phone and order a full system which can be delivered within the week. Which is exactly what I did.

I started with some basic criteria. First, I wanted a system that wasn't strung together with cables and expansion boxes. Second, I wanted built-in disks and a proven operating system. Finally, I wanted a system that would accept Microsoft BASIC.

I had just about chosen the Superbrain when Tandy unveiled the Model III. Both computers sounded as if they were what I was looking for. I

took the trip to a nearby Radio Shack computer store.

There it was sitting on the shelf—the Model III with dual disks, Microsoft BASIC and TRSDOS. What more could you ask for? I wanted to tuck it under my arm and leave, and the salesperson knew it.

Then he turned it on. It couldn't be true—a 64 character by 16 line format, just like the Model I. I had expected an 80 by 24 format.

It was then that I decided. Since I wanted my system for text writing and editing, I felt that I needed an 80-character format. I placed my order for the Superbrain.

## Vital Stats

Since I had never used a CP/M

operating system, I had a few fundamentals to learn. The first two chapters of the manual give a brief overview of the hardware. Its vital statistics include:

- The Superbrain uses two Z-80 microprocessors, one for computing and screen functions and one for disk I/O. Both operate at 4 MHz.

- Two types of disks are available: single-sided double-density and double-sided double-density (quad density). They hold over 350K and 700K bytes respectively.

- Two memory sizes, 32K bytes and 64K bytes, are available.

- The display size is 80 characters by 24 lines, with upper- and lowercase displayed in a 5×7 matrix on a 7×10 field. A 15 MHz CRT is used.

- There are two built-in RS-232 asynchronous serial ports and a 40-pin Z-90A data bus. Intertec sells an optional S-100 adapter for this bus.

- The main 62-key keyboard has a standard character set plus an alpha caps-lock, backspace, linefeed, break, delete, escape, here is, control, return and a set of reset keys which must be pressed at the same time to cause a system reset. An 18-key numeric keypad has its own enter key and four cursor control keys.

- The operating system is CP/M version 2.2.

## System Programs

The programs provided on the original diskette are shown in Table 1. Some of the programs unique to the Superbrain include 32CPM5/1, 32CPM5/5, 64CPM5/1 and 64CPM



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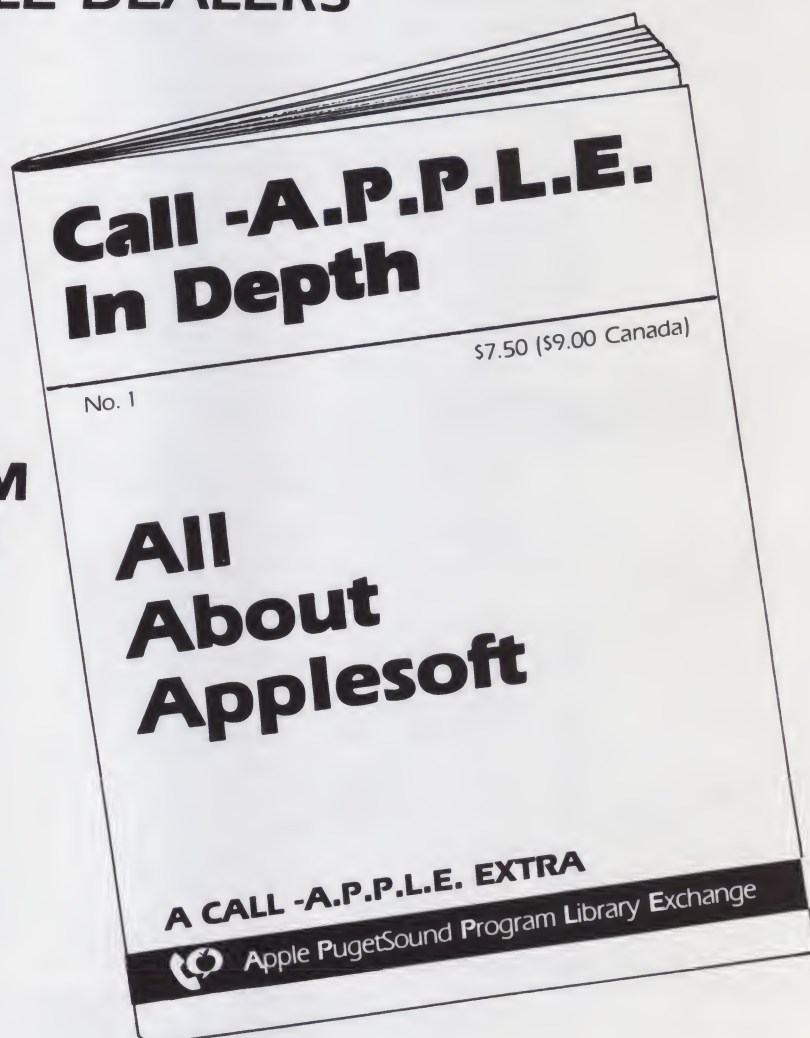
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5/5. All are different operating systems for use with 32K and 64K machines. The two programs ending in /1 are used to convert programs created on earlier versions of the Superbrain to the present system. The only one of the above programs I use is 64CPM5/5, to put the operating system on a newly-formatted diskette.

The programs 32K TEST and 64K TEST are memory exercise tests to verify that the RAM is okay.

The FORMAT program does what it implies—formats new diskettes.

The TX and RX programs are used to transmit serial data through the RS-232 ports. The program TX/RX.-DES is a description of the TX and RX programs.

SYSTEM.DES is a Superbrain DOS 3.0 description.

The program 32BS5/5.ASM is an assembly-language program which can be used to modify the BASIC I/O system.

The CONFIGUR.COM program lets you configure the main and auxiliary RS-232 ports to match the Superbrain to a peripheral piece of equipment. CONFIGUR allows you to set the baud rate (up to 9600 baud), number of character bits, number of stop bits and parity status for either port, and also handshaking on the auxiliary port.

You may also configure the disk system to allow disk read-after-write verification. After making your changes, a new operating system is written onto your disk until you need to configure again.

The rest of the CP/M programs make Superbrain a powerful machine for assembly-language programming and file handling.

My favorite computer-based language, however, is BASIC, and Microsoft BASIC is the best of all those available. So after backing up and properly labeling my MBASIC5 diskette, I was ready to get started.

(By the way, to run MBASIC5 on the Superbrain you need a 64K system. While Microsoft was packing all that power into MBASIC5, they made the interpreter 26K long. With this and a 12K monitor there's just not enough room in a 32K machine. With 64K you wind up with 28187 bytes of available program space, which is enough for most programming needs. If you need more room, MBASIC5 makes it easy with the CHAIN command.)

The power of MBASIC5 has been discussed in several articles appear-

ing previously in this journal. Some unique features of the Superbrain let you use MBASIC5 for some sophisticated programming. A few examples include:

*Absolute cursor addressing.* A BASIC statement of the type

```
100 PRINT CHR$(27)"Y"CHR$(ROW + 32)
CHR$(COL + 32);
```

where ROW ranges between 0 and 23 and COL ranges between 0 and 79 will place the next print position anywhere on the screen. ROW=0 and COL=0 is the upper left-hand corner.

*Erase to end of line.* The statement

```
110 PRINT CHR$(27)CHR$(126)"K";
```

will erase data from the current cursor position to the end of the current line.

*Erase to end of page.* The statement

```
120 PRINT CHR$(27)CHR$(126)"k";
```

will erase data from the current cursor position to the end of the screen.

Combinations of the statements can provide some interesting split screen programming. One of my favorites is

#### BLINKING:

Using certain CHR\$ codes in a BASIC program can make a character or group of screen characters blink. This feature can be used to make important portions of your displayed text or prompts blink on and off.

In BASIC, a statement of the type

```
200 PRINT CHR$(27)CHR$(126)"B";
```

turns on the blinking mode for any text that follows and

```
220 PRINT CHR$(27)CHR$(126)"b";
```

turns the blinking mode off. Any text printed to the screen between these two statements will blink, but the rest of the screen will have normal characters. Any text set in the blinking mode will remain blinking until it is scrolled off the screen.

*Reverse video.* For those of you who would rather look at black on a white background, you can reverse the video with an OUT command from BASIC. The statement

```
250 OUT &H68,&HC3
```

will reverse the video system to a white background, while the statement

```
260 OUT &H68,&H43
```

will set the video back to normal.

*Display control characters.* There are another 32 special characters corresponding to the control code values. They consist of arrows pointing in all four directions, plus two more arrows in the up-left direction and in the down-left direction. Other graphics included in this set are a small bell corresponding to the keyboard's CTRL"G" command and various other underlined numbers and letters, plus a set of up and down chevrons.

To get at these characters from BASIC you again use the CHR\$ codes. The statement

```
300 PRINT CHR$(27)CHR$(126)"E";
```

will enable the transparent mode for these control characters. A following statement of the type

```
310 PRINT CHR$(X);
```

where X is between 0 and 31, will produce one of the control codes printed on the screen. If X falls between 128 and 160, the control codes will be displayed in the blinking mode.

*Cursor Controls.* As stated previously, the numeric keypad has a set of cursor control keys labeled with arrows in four directions. These keys plus the tab key on the standard keyboard are all functional under BASIC, and are handy for text editor programs. The break key is not allocated in BASIC and may be used in any fashion you wish under program control.

#### Conclusions

I have not covered all the features of the Superbrain. But I hoped to get across that other computers are out there. These computers offer many special features which a computer user may want or need in his application; we shouldn't ignore them because we don't read about them regularly. ■

32CPM5/5	COM	64CPM5/5	COM	32CPM5/1	COM
64CPM5/1	COM	32KTEST	COM	64KTEST	COM
FORMAT	COM	32BS5/5	ASM	SYSTEM	DES
TX	COM	RX	COM	TX/RX	DES
CONFIGUR	COM	HEXDUMP	COM	SUBMIT22	COM
XSUB22	COM	ED22	COM	DUMP22	COM
ASM22	COM	LOAD22	COM	SYSGEN22	COM
STAT22	COM	PIP22	COM	DDT22	COM

Table 1. System diskette programs.



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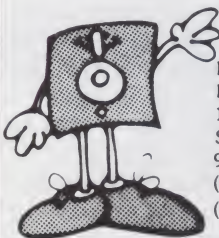
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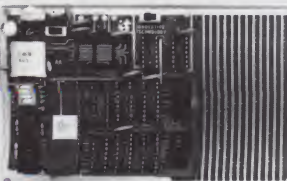
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# Poor Man's Memory Expansion for the OSI

By John E. Young

The Ohio Scientific Superboard II and Challenger C1P are excellent values for the money, giving you up to 8K memory, an 8K BASIC-in-ROM, cassette interface, 50 key upper and lowercase keyboard, and many other features on a single board. All you need to add is a TV or monitor and a cassette recorder, and you are up and running.

But as the saying goes, "Into every life some rain must fall." Expansion of this computer is a rather expensive proposition—the OSI 610 expansion board with an additional 8K memory

is \$300, a cost very nearly equal to that of the original computer system. The 610 board does have a number of other features—sockets and decoding for a total of 24K memory, peripheral interface adapter for use with disk drives and buffering of all signals for use with an expansion bus that can be purchased separately. But if you're interested only in expanding memory, the 610 board is too expensive.

Fortunately, I've found a very inexpensive way to add up to 16K additional memory. The interface board described here couples the new memory board to the OSI computer as well as a 44-pin bus, which will let you construct and add peripherals at minimum cost.

In addition, you can double the baud rate for the cassette interface, to improve the speed with which you can load programs or data into the expanded memory.

## OSI Expansion Capabilities

The main CPU board of the Superboard II/C1P (600 board) has a 40-pin DIP socket for connecting most peripherals that require parallel data. This socket provides output for the address, data and necessary control signals. The pin assignments for this socket are shown in Fig. 1.

The bidirectional data lines are buffered on the 600 board by means of 8T28 transceivers. The 600 board ac-

tually contains only the sockets for these two 8T28s; you must install these in the U6 and U7 positions to use the expansion connector.

The direction of data through the transceivers is controlled by the DD signal that is generated by whatever peripheral is using the data lines at any moment. More details regarding the DD signal will be presented later, in the discussion of the memory board and the interface circuits.

The 16 address lines, clock (Ø2), and read/write (R/W) signals are not buffered on the OSI 600 board, so buffers must be provided on an interface board. In addition, interrupt re-

GND	• 40	1 •	IRQ
GND	• 39	2 •	NMI
GND	• 38	3 •	DD
GND	• 37	4 •	BDO
BD4	• 36	5 •	BD1
BD5	• 35	6 •	BD2
BD6	• 34	7 •	BD3
BD7	• 33	8 •	GND
R/W	• 32	9 •	GND
Ø2	• 31	10 •	GND
GND	• 30	11 •	N/C
GND	• 29	12 •	A2
GND	• 28	13 •	A1
A15	• 27	14 •	A0
A14	• 26	15 •	A3
A13	• 25	16 •	A4
A12	• 24	17 •	A5
A11	• 23	18 •	A6
A10	• 22	19 •	A7
A9	• 21	20 •	A8

Fig. 1. Pin assignments for OSI 40-pin DIP socket.

Address correspondence to John E. Young, 6701 King Court, Woodridge, IL 60517.

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		• 20	X •	
		• 19	W •	B R/W
DD		• 18	V •	B R/W
		• 17	U •	BØ2
		• 16	T •	BA15
BDO		• 15	S •	BA14
BD1		• 14	R •	BA13
BD2		• 13	P •	BA12
BD3		• 12	N •	BA11
BD4		• 11	M •	BA10
BD5		• 10	L •	BA9
BD6		• 9	K •	BA8
BD7		• 8	J •	BA7
		• 7	H •	BA6
NMI		• 6	F •	BA5
		• 5	E •	BA4
IRQ		• 4	D •	BA3
		• 3	C •	BA2
		• 2	B •	BA1
		• 1	A •	BA0

Fig. 2. Edge connector for 44-pin bus.



quest (IRQ) and nonmaskable interrupt (NMI) lines are included for CPU control by external peripherals. The socket is wired so that when a 40-conductor ribbon cable is connected to the socket, the clock and control signals 02, R/W, DD, IRQ and NMI are isolated from each other and the data and address lines by means of ground lines to minimize possible interaction among these signals. There is one unused pin in the 40-pin socket that could be used for some other signals as the need arises in the future.

These signals should provide for the fundamental needs of just about any peripheral you would attach to an expansion bus. Additional control signals can be synthesized as necessary, such as the two extra signals required by the memory board used in this expansion.

### Bus Structure

To minimize cost, the bus is based on double-sided 22/44 pin sockets with 0.156 inch spacing. These connectors are readily available, either in solder or wire-wrap configuration. These sockets accept 4 x 4.5 inch hobby prototyping boards, which are quite inexpensive yet hold an adequate number of ICs if space is used efficiently. The interface between the OSI 600 board and the memory expansion board is constructed on one of these boards and fits into one slot of the bus.

The pin assignments for the bus are essentially the same used in KIM-type buses, but a number of the KIM control signals are omitted, since they are not available from the OSI 600 board. The pin assignments for the bus are shown in Fig. 2. 02 and R/W are not directly supplied by the OSI 600 board but are generated and buffered on the interface board and then supplied to the bus. There are a number of unused lines in the bus which can be used for specialized sig-

nals as peripherals are added to the system.

I have included both a 14-V unregulated and a 5.0 V regulated line on the bus. The 5.0 V line is controlled by the 7805 voltage controller powering the interface board. The interface board uses less than 200 mA of the 1500 mA capacity of the 7805, so if a peripheral board is constructed that contains a moderate number of ICs, it can be powered from the 5.0-V line. Otherwise, the peripheral should have its own voltage regulator powered from the 14-V unregulated line.

### Memory Expansion Board

The memory board used in this system is a 16K static RAM board designed for the SS-50 bus (SWTP 6800 computer) and sold by Digital Research Corp. (PO Box 401565, Garland, TX 75040). Digital Research currently sells the bareboard for \$30. This board uses 2114s, which can now be bought for about \$4 each. All support components for this board are readily available and inexpensive (\$2 for the most expensive chip). All told, you can buy and assemble this board with 8K memory for \$100-\$125, and when you add the cost of

Hex Code	Address	Line 15	Line 14	Line 13	Line 12	Line 11	Line 10
1 F F F	L	L	L	H	H	H	
2 0 0 0 <sup>(1)</sup>	L	L	H	L	L	L	
3 F F F	L	L	H	H	H	H	
4 0 0 0	L	H	L	L	L	L	
5 F F F <sup>(2)</sup>	L	H	L	H	H	H	
6 0 0 0	L	H	H	L	L	L	
7 0 0 0	L	H	H	H	L	L	

(1) Starting address for 16K memory expansion  
(2) Final address for 16K memory expansion

Fig. 3. Binary coding of high order address lines for hex 2000 to 5FFF.

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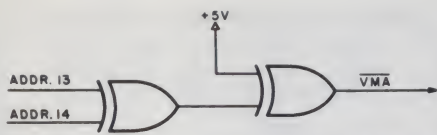


Fig. 4. Exclusive OR gate for generating  $\overline{VMA}$  signal needed by memory board.

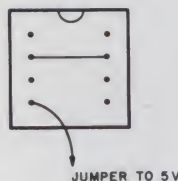


Fig. 5. Jumper configuration for memory address selection on the Digital Research memory board.

the interface board and bus sockets, you still have laid out only about half the cost of the OSI 610 board.

The board has its own voltage regulators, so you need to supply at least 8 V of unregulated power. All data, address and control lines are directly available from the OSI 600 board (through appropriate buffers) with the exception of two— $\overline{O2}$  and  $\overline{VMA}$  (valid memory address). These signals are synthesized on the interface board.

The memory on the Digital Research board is addressed in 16K blocks starting from address 0000, 4000, 8000 or C000 hex. The 16K memory expansion for the OSI system must start at 8K (2000 hex) and end at 24K (5FFF hex), so the memory addressing scheme on the Digital Research board must be modified. The binary configuration of the high order address lines for the appropriate hex addresses is shown in Fig. 3. As can be seen from this chart, for the range of memory addresses of interest for the OSI expansion, either address line 13 or 14 is high. For addresses outside the critical range, lines 13 and 14 are either both low or both high. Hence an exclusive OR gate can be used to generate the  $\overline{VMA}$  signal for the memory board. The schematic of the exclusive OR gate is shown in Fig. 4, which is actually installed on the interface board described later.

To complete the modified address decoding, the address selection jumpers normally used on the Digital Research board must also be changed. The selection is carried out by means of jumpers installed in an eight-pin socket on the memory board. Rather than using any of the configurations

shown on the Digital Research instruction sheet, the scheme shown in Fig. 5 is used. Only one conventional jumper is used—between pins 2 and 7. Pin 4 is tied high by means of a jumper to somewhere on a regulated 5.0-V line.

Because of the modified address decoding, the first 8K of the 16K available of the board resides at the high end of the memory board. If you populate only half the memory board, the 2114s must be installed in sockets 9 through 16 and 25 through 32 rather than 1 through 8 and 17 through 24.

The data direct (DD) signal needed by the transceivers on the OSI 600 board is taken from the memory

board by running a jumper from either pin 8 of IC 35 or pin 15 of ICs 38, 39 or 40 of the memory board to an unused spot on the 50-pin connector area at the edge of the board.

Rather than attach a plug-in connector to the edge of the memory PC board, I simply soldered two 16-conductor ribbon cables directly to the terminations at the board edge. At the other end of each of the ribbon cables is a standard 16-pin DIP connector. Hence the memory board is connected directly to the interface board by means of these cables, rather than going through the hassle of wiring up a single 50-pin edge connector dedicated to the memory board.

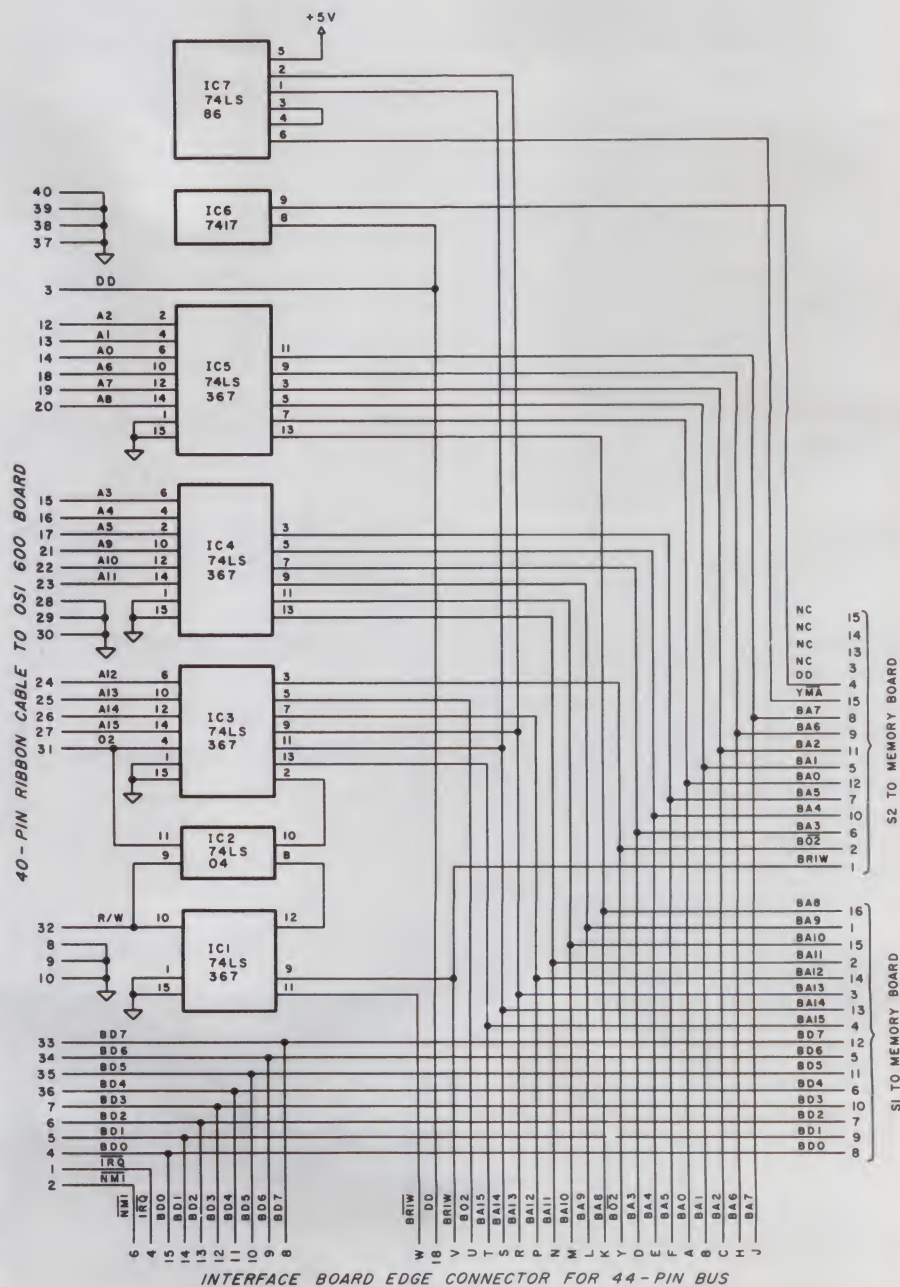


Fig. 6. Schematic of interface board.



## Interface Board

This board supplies the signal buffering and modification necessary for both the memory board and the bus. The overall schematic of this board is shown in Fig. 6. 74LS367s are used for buffering of the address lines, R/W and  $\overline{O2}$ . (OSI's R/W is equivalent to the Digital Research R/W signal.) There are four unused buffers in IC1 in case additional signals are brought into the bus or from the OSI 600 board. Since it was necessary to produce an inverted  $\overline{O2}$  for the memory board, the buffered  $\overline{O2}$  is sent to the bus as well, in case any other peripheral requires  $\overline{O2}$ . An inverted read/write signal ( $\overline{R/W}$ ) is also generated, buffered and sent to the bus. The exclusive OR gate necessary to generate the VMA signal for the memory board uses two of the four gates on a 74LS86.

This board contains the 40-pin DIP socket for the ribbon cable coming from the OSI 600 board, wired according to Fig. 1. Two 16-pin DIP sockets are wired according to Fig. 7 for the ribbon cables leading to the memory board. The connector sockets and interface ICs are all installed in the interface board using wire-wrap connections.

The data direct (DD) line tells the computer that a peripheral is putting valid data onto the bus. This line is held high by a voltage divider on the OSI 600 board and must be pulled low (sinking approximately 23 mA) by any peripheral transmitting to the bus. This can be done with a 7417, an open collector driver capable of sinking 40 mA.

With open collector drivers on each peripheral that supplies a DD signal, a high impedance path is presented to the bus unless it is pulled low by its own peripheral. In this way, current through the DD line and the drivers held in the low state is limited to the 23 mA supplied by the pull-up divider at the transceivers. The 7417 for the DD signal supplied by the memory board is located on the interface board.

The  $\overline{NMI}$  and  $\overline{IRQ}$  lines to the OSI 600 board are fed directly from the bus without intermediate drivers. OSI holds these lines high at the 6502 CPU chip with 4.7k resistors. Open collector buffers such as the 7417 should be used in this case also, since there will be a possibility of multiple peripherals driving one or the other of these interrupt lines.

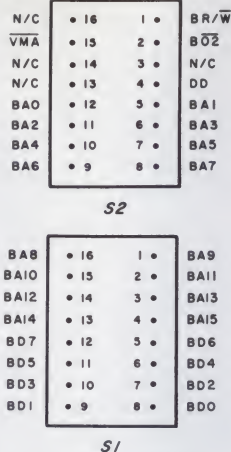


Fig. 7. Sockets for two 16-conductor ribbon cables to memory board.

## General Construction Considerations

The complete system is constructed in a box 8×12×6 inches. This box contains a seven-slot bus and the memory board, which is attached to spacers along one side of the box. Unregulated 14 V dc is supplied to the box from a separate 10-amp power supply. The edge connectors for the

bus are mounted on 3/4×3/4 inch aluminum angles that run from end to end of the box. I have used wire-wrap connectors for the bus. An inexpensive 22/44-pin motherboard is available from Electronic Systems in San Jose, CA, that would simplify wiring of this bus.

Now that you have significantly expanded your memory from 8K to 16 or 24K, you will quickly realize that loading that much data or program material from cassette tape at the Kansas City standard of 300 baud takes ages! You can easily cut that time in half with a very simple modification to the OSI 600 board.

OSI uses a 6850 asynchronous communications adapter for control of serial data. The transmit clock (pin 4) and the receive clock (pin 3) inputs of the 6850 are tied together on the PC board and driven by output from the clock counter. The trace on the PC board must be cut just beyond where the pins 3 and 4 are tied together. Leads are then soldered to each cut end of this trace and run to the prototype section of the board.

In this section of the board, I placed a 16-pin socket and a 74LS151 multi-

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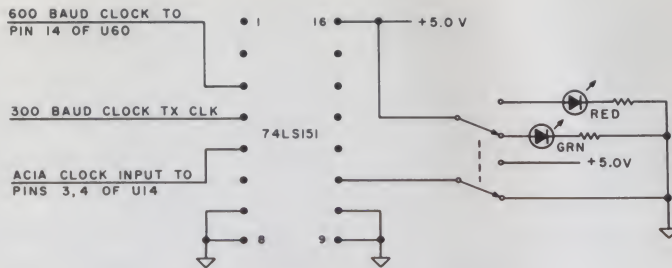


Fig. 8. Baud rate selector and indicator.

plexer. The multiplexer is used to avoid putting the clock pulses directly through the switch. Direct switching of the clock signals may not lead to problems, but this is a simple, yet elegant, way of doing the job. The clock signal for the 600 baud rate is obtained from pin 14 of U60. The switch then ties one select input on the multiplexer either high or low.

The wiring scheme is shown in Fig. 8. The output of the multiplexer (pin 5) is connected to the clock input of the 6850 (pins 3, 4). The 300-baud clock input, taken from the other end of the cut trace (actually called the TX CLK signal), is input to pin 4 of the multiplexer. The 600 baud clock

signal is input to pin 3. The enable signal (pin 7) and select lines 1 and 2 (pins 9 and 10) of the multiplexer are grounded. Select line 0 (pin 11) of the multiplexer is wired to one pole of a DPDT miniature toggle switch mounted on the front panel of the computer next to the keyboard. I added indicator LEDs—a green one for the standard 300 baud and a red one for 600 baud.

I did not have to change the capacitors in the cassette audio input section for use with 600 baud. Because I wanted to preserve the standard 300-baud operation in order to use commercial software, I wanted to avoid having to make this change.

Operation in the 600-baud mode has been just as reliable as with the 300 baud, using a cheap cassette recorder and cheaper cassettes. Even at 600 baud, cassette read-and-write operations take a considerable amount of time for large blocks of information. I am currently investigating ways of improving this situation, without going to a disk system.

## Conclusion

With this setup, I have doubled my system memory with the capability of adding yet another 8K, and have a six-slot bus structure that will permit considerable experimentation with peripherals. All this has been obtained for half the cost of the OSI expansion board. Types of peripherals that I envision constructing for my bus are a multichannel A/D converter for home monitoring, ac switching gear for home control and sound or music boards. OSI now has these types of options available in their larger computer systems, but all that is at a price. Besides—it's more satisfying to know that you've done it yourself. ■

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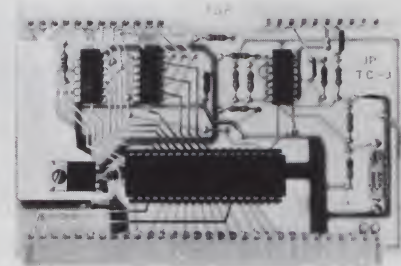
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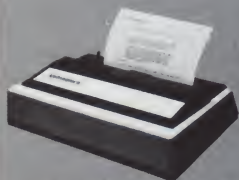
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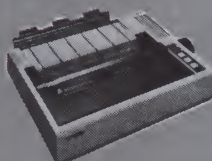


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# Take a Byte Out of Your Energy Bills

By Paul J. Boudreaux

Sooner or later everyone gets infuriated when he finds that the local utility company plans to raise their rates again. This time I decided to dig out my old bills to see just what had been done to me over the last few years.

After assembling the records it occurred to me that there was more here than met the eye. As a practicing experimental research physicist, I recognized that this was a record of the energy used by my house for the past several years which reflected the local environmental stresses for each month. I also knew that to maintain a thermal balance in the home, the total energy put into the house had to equal the total energy flowing out of the house. Here then was a way of directly measuring the heat flow and the thermal resistance of my insulation and weatherproofing.

Thus, by using my utility bills, I wrote a BASIC program for my F8 system that will determine the effective insulating capability, or R-value, of my house. The 9K floating-point BASIC version used on my homebrew F8 system was by Micro Business Systems, Inc., Box 8255 JFK Sta., Boston, MA 02114, who used the Fairchild FAIRBUG PSU ROM chip.

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The thermodynamics of home energy is complex and far beyond the scope of this article, but certain simplifications can be made.

Heat flow takes one of three forms: radiation (e.g., sunlight striking the roof), convection (e.g., hot air rising up a chimney) and conduction (e.g., the flow of heat through a wall). Although radiation and convection play important roles in the energy balance of a house, I'll concentrate on conduction.

Since conduction is generally the major heat-flow mechanism in the house, this simplifies things enormously. In this model, the relationship between conduction heat flow (H) and environmental temperature (T) is expressed as equation 1 in Table 1. H is expressed in British thermal units (BTUs), or the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.

The inside and outside temperature difference is expressed by (Tin-Tout). A is the cross sectional area through which the heat flows and L is the length that it must travel.

K is a constant of proportionality called the thermal conductivity. In the English system used in the U.S., K is numerically equal to the number of BTUs of heat energy conducted in one hour through a slab one inch thick and one square foot in cross section when the temperature difference between the faces of the slab is one degree Fahrenheit (F).

Although the K value of any insulation can be found in physical constant tables, insulation is usually measured by a quantity called its R-value. The R-value of a material is simply its thickness in inches divided by the thermal conductivity. Thus, part of equation 1, K/L, is given for any particular piece of insulation by the reciprocal of its R-value. To determine the R-value, you have to find the total area of insulation in square feet and the temperature difference between the inside and outside of the house in degrees Fahrenheit occurring for one hour. This is shown as equation 2 in Table 1, and forms the basis for the program shown in Listing 1.

Knowing all these facts would be great if I were taking a high school physics exam, but I'm really after home insulation efficiency. I still need a measurement of the temperature during the month. This information could be obtained from the local TV weatherman, but there is a much more useful quantity called a "degree day."

$$H = \frac{KA}{L}(\text{Tin-Tout}) \text{ Equation 1}$$

$$H = \frac{A}{R}(\text{Tin-Tout}) \text{ Equation 2}$$

Table 1.



Listing 1. BASIC Home Insulation Efficiency program.

```

5 RESTORE
10 DIM D$(72)
20 DIM M$(36)
40 DIM T$(55)
50 DIM V$(80)
60 DIM Y$(4)
70 DIM X$(66)
76 DIM E(12,9)
77 DIM G(12,9)
78 DIM H(12,9)
79 DIM F(12,9)
80 DIM T(12)
110 DIM P(12,9)
120 DIM Q(12,9)
140 REM A IS EXTERIOR AREA IN SQ.FT.
142 A=3375
144 REM Y0=BEGIN YR, Y1=END YR
148 Y0=1973
149 Y1=1980
150 V$=" ELECT. (KWH X GAS (THERMS X ENERGY (KWH X HEAT+COOL(D.D.X "
151 V$=V$+"( BTU/DEG.DAY X "
160 T$="ELECTRICITYNATURAL GASTOT. ENERGYDEGREE DAYSEGY/DEG.DAY"
170 M$="JANFEBMARAPR MAYJUNJLYAUGSEPOCTNOVDEC"
180 X$="I-----I-----I-----I-----I-----I-----I-----I-----I-----I"
200 REM 1 GAL #2 OIL=1.4THERM, 1THERM=100000BTU=29.302KWH
210 REM 1 KWH = 0.034127 THERM
218 T=0
220 FOR M=1 TO 12
230 READ T(M)
235 T=T+T(M)
240 NEXT M
250 L=10000
260 O=10000
300 FOR Y2=Y0 TO Y1
310 Y=Y2-INT(Y2/10)*10
320 FOR M=1 TO 12
330 READ E(M,Y),F(M,Y)
340 NEXT M
350 NEXT Y2
355 J=0
358 JO = 0
360 PRINT"DO YOU HAVE ELECTRIC HEATING FOR YOUR HOME? (YES OR NO)";
370 INPUT Y$
375 IF Y$(1,1) = "Y" THEN JO = 1
380 IF Y$(1,1)="Y" THEN 485
382 PRINT"DO YOU HAVE OIL HEATING FOR YOUR HOME? (YES OR NO)";
384 INPUT Y$
386 IF Y$(1,1)="Y" THEN J=1
400 FOR Y2=Y0 TO Y1
410 Y=Y2-INT(Y2/10)*10
420 FOR M=1 TO 12
430 READ G(M,Y),H(M,Y)
435 IF J=1 THEN G(M,Y)=1.4*G(M,Y)
440 NEXT M
450 NEXT Y2
482 IF J=1 THEN T$(12,22)="HEATING OIL"
484 IF J=1 THEN V$(17,32)=" OIL (THERMS X "
485 PRINT
730 PRINT
740 PRINT"          YEARLY COST OF UTILITIES ($ DOLLARS )"
750 PRINT
760 PRINT"YEAR",T$(1,11),T$(12,22),T$(23,33);"    COST/DEG./DAY"
765 PRINT
766 P=0
767 Q=0
770 FOR Y2=Y0 TO Y1
780 Y=Y2-INT(Y2/10)*10
790 C=0
800 F=0
820 H=0
830 FOR M=1 TO 12
835 READ Q(M,Y),P(M,Y)
840 H=H+H(M,Y)
850 F=F+F(M,Y)
870 C=C+P(M,Y)+Q(M,Y)
875 P=P+P(M,Y)
876 Q=Q+Q(M,Y)
880 NEXT M
890 PRINT Y2,F,H,F+H,(F+H)/C
900 NEXT Y2
920 U1=0
930 PRINT
935 PRINT
940 PRINT"U IS THE AVE. BTU/(DEG*HR*SQ.FT.). R = 1/U"
941 PRINT"T IS THE AVERAGE MONTHLY TEMPERATURE OVER 30 YEARS"
942 PRINT
943 PRINT"          U          R          T"
944 PRINT
950 FOR M=1 TO 12
951 U=0
952 FOR Y2=Y0 TO Y1
953 Y=Y2-INT(Y2/10)*10
954 E1=.5
955 E2=.5
960 U=U+(E(M,Y)*E1*.034127+G(M,Y)*E2)*100000/((P(M,Y)+Q(M,Y))*A)
965 NEXT Y2
966 U=U/(24*(Y1-Y0+1))
970 PRINT M$(3*M-2,3*M);"          ";U;"          ";1/U;"          ";T(M)
980 U1=U1+U
990 NEXT M
1000 PRINT
1010 PRINT"THE AVERAGES FOR ";Y0;" TO ";Y1;" ARE:"
1020 PRINT"          U = ";U1/12
1025 PRINT"          R = ";12/U1
1030 PRINT"          T = ";T/12

```

More

The concept of a degree day is based on the fact that the fuel used to keep a building interior heated to 70 degrees F is proportional to the number of hours that the outside temperature is below 65 degrees F. Heating-fuel suppliers developed this concept further to predict their customers' needs and thereby keep their reserves adequate.

For the purpose of our calculation, a degree day is the difference between the daily mean temperature and 65 degrees F. It is always a positive number. Each degree of mean temperature below 65 degrees F is one heating degree day. Weather stations measure the hourly temperature and calculate the average daily temperature by adding them together and dividing by 24. They use this mean temperature to determine the degree day value.

A simpler method is sometimes employed which uses the median temperature instead of the mean. The median temperature of a day is the halfway point between the highest and lowest temperature existing during a 24-hour period. For example, if the highest temperature during the day were 42 degrees F and the lowest 18 degrees F, the median would be  $(42 + 18)/2 = 30$ , and the degree day entry would be  $(65 - 30) = 35$ . This concept is so important that all U.S. weather stations record daily, monthly and seasonal totals.

Since we are concerned with the consumption of heating fuel, days during the heating season when the mean temperature does not drop below 65 degrees F are ignored in the cumulative totals for heating degree days. In a similar manner, cooling degree days are those for which the mean temperature is above 65 degrees F, and for which cooling energy loads are evaluated.

The National Weather Service collects and records both heating and cooling degree days for most locations in the U.S. This data for your local area, along with a 30-year average for the monthly temperature, is available annually from the National Oceanic and Atmospheric Administration (NOAA). The pamphlet is called the "Local Climatological Data Annual Summary with Comparative Data," 1981 (specify your local area). They will also supply an additional pamphlet called "Heating and Cooling Degree Day Data, Environment Information Summaries C14." It's useful if you want to learn more



Listing continued.

```

1040 PRINT"AVE # HEATING DEGREE DAYS PER YEAR = ";Q/(Y1-Y0+1)
1050 PRINT"AVE # COOLING DEGREE DAYS PER YEAR = ";P/(Y1-Y0+1)
8000 PRINT
8010 PRINT
8020 PRINT"DATA KEY:"
8030 PRINT"      + = SINGLE DATA POINT"
8040 PRINT"      * = MULTIPLE DATA POINT"
8050 PRINT"      # = MONTHLY AVERAGE"
8060 PRINT"      < = BELOW RANGE"
8070 PRINT"      > = ABOVE RANGE"
8900 FOR I=0 TO 4
8910 IF I=0 THEN W=50
8920 IF I=1 THEN IF J=0 THEN W=5
8922 IF I=1 THEN IF J=1 THEN W=10
8924 IF I=1 THEN IF J=1 THEN 9260
8930 IF I=2 THEN W=250
8940 IF I=3 THEN W=50
8950 IF I=4 THEN W=2000
8990 FOR K=1 TO 5
8991 PRINT
8992 NEXT K
9000 PRINT"      ";T$(I*11+1,(I+1)*11);" USED PER MONTH"
9010 PRINT
9020 PRINT V$(I*16+1,(I+1)*16);
9021 PRINT W/5;" 75    100    150    200    250    300"
9030 PRINT"      ";X$
9040 FOR M=1 TO 12
9050 DO=0
9060 N=0
9070 D$=""
9075 Z=1
9080 FOR Y2=Y0 TO Y1
9081 Y=Y2-INT(Y2/10)*10
9089 IF I=4 THEN IF J=1 THEN O=0
9090 IF I=0 THEN E=E(M,Y)
9100 IF I=1 THEN E=G(M,Y)
9102 IF I=2 THEN E=G(M,Y)*29.302+E(M,Y)
9104 IF I=3 THEN E=P(M,Y)+Q(M,Y)
9105 IF I=4 THEN E=((E(M,Y)-L)*.034127+G(M,Y)-O)*100000/(P(M,Y)+Q(M,Y))
9106 IF E=0 THEN 9180
9107 IF I=1 THEN IF O>E THEN O=E
9108 IF I=0 THEN IF L>E THEN L=E
9110 DI=E/W
9115 IF DI<1 THEN D$(1,1)=""<"
9116 IF DI<1 THEN 9175
9120 D=INT(DI)
9125 IF D>65 THEN D=65

```

More

about degree days.

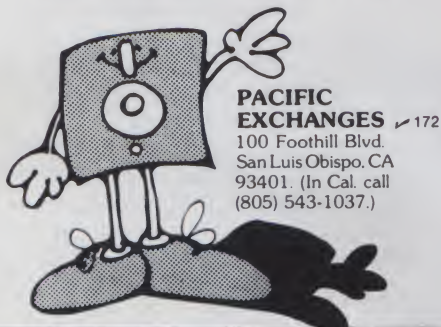
The above documents, and a number of other pamphlets, are available from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, Federal Building, Ashville, NC 28801, for a \$3 postage and handling charge. Very often the public library has these or equivalent publications which contain this information. The local TV station forecaster is also a good source.

Although these temperatures-only techniques are satisfactory, they don't take into consideration the unique environmental conditions of your home, such as the number of hours of sunshine, wind speeds, house orientation and deciduous trees. However, these parameters are included in each month's evaluation simply by their presence in the utility bill, and thus in the effective R-value for the whole house. Equation 2 of Table 1 shows that if you know the total heat input (H) used by the house for a month (i.e., heating bill data) and the heating degree days for that

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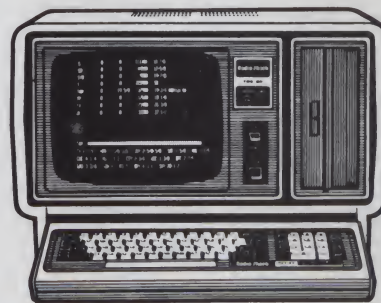
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month (Tin-Tout) along with the exposed area of the house, you can evaluate the effective R-value.

## What the Program Does

The program shown calculates the yearly cost of utilities and determines the energy cost per degree per day during that year. Next, the effective R-value for the house is evaluated for each month.

A monthly value is used because environmental changes alter the heat balance. For example, during the spring and early fall most people open their windows for fresh air. This conductivity model clearly breaks down during this transition period from heating to air conditioning or vice versa.

The program then prints five graphs. Electricity consumed per month over the years is plotted first. Heating fuel followed by total energy used (after suitable energy units have been converted) is next. The total number of heating plus cooling degree days is represented for each month during the years covered. The last plot is the monthly energy expended per degree per day.

Listing continued.

```

9126 IF D=65 THEN D$(D,D)=">"
9127 IF D=65 THEN 9175
9130 DO=D0+D1
9140 N=N+1
9150 IF D1-D > .5 THEN D=D+1
9160 IF D$(D,D)<>" " THEN D$(D,D)="*"
9170 IF D$(D,D)=" " THEN D$(D,D)="+"
9175 IF D>=Z THEN Z=D
9180 NEXT Y2
9190 DO=INT(D0/N)
9200 D$(D0,D0)="#"
9205 PRINT"      I"
9210 PRINT M$(3*M-2,3*M); "      I"; D$(1,2)
9220 PRINT"      I"
9225 PRINT"      I"
9240 NEXT M
9250 PRINT"      "; X$
9260 NEXT I
10000 END
10001 REM AVE 30 YR MONTHLY TEMP
10010 DATA 32.7,34.8,43.3,53.9,63.2,72.2,76.7,75.5,68.7,57.0,46.2,36.6
10990 REM ELCTRICITY USAGE & MONTHLY COST
11000 DATA 0,0,0,0,440,14.59,800,22.67,740,21.31
11001 DATA 1650,42.74,2540,61.95,3180,76.43,2830,68.33,1830,46.85,860,25.10
11002 DATA 850,26.98,1000,30.10,890,29.53,810,29.63,820,31.82,910,34.30
11003 DATA 1660,60.83,2460,87.41,2160,80.94,2240,84.81,1230,50.13,780,34.01
11004 DATA 900,38.09,1060,41.93,920,37.69,960,37.60,820,33.25,790,32.57
11005 DATA 1560,60.83,2790,107.84,2660,102.49,2140,87.61,1090,48.10,890,39.49
11006 DATA 850,38.65,1110,46.76,990,42.56,930,42.39,850,39.52,980,42.73
11007 DATA 1270,57.76,2460,102.27,2730,100.76,1180,65.99,1110,51.06,800,38.42
11008 DATA 880,40.70,1080,46.60,990,49.56,820,43.14,800,42.31,620,33.54
11009 DATA 1270,66.94,2110,104.37,2170,109.54,2100,104.83,1060,57.29,710,38.00
11010 DATA 970,46.74,980,48.32,960,50.43,830,45.86,740,40.51,800,42.69
11011 DATA 1080,58.24,1760,98.69,2140,117.02,2300,121.88,1210,67.54,820,46.26
11012 DATA 940,50.78,1130,51.81,930,48.98,1090,54.77,760,42.24,770,43.63
11013 DATA 1140,64.82,1270,68.82,2450,124.94,1720,90.22,790,45.92,780,43.43
11014 DATA 950,50.87,1100,56.51,840,46.72,880,47.21,820,45.02,710,40.08
11015 DATA 1110,62.04,2520,134.39,1740,95.75,2080,115.95,1090,64.77,890,50.56
11016 DATA 900,50.97
11990 REM NATURAL GAS USAGE & MONTHLY COST
12000 DATA 0,0,0,0,0,0,0,95.2,16.85,57.7,-3.25
12001 DATA 41.5,5.50,14.2,4.30,78.0,14.29,18.2,5.07,96,17.49,205.8,34.62
12002 DATA 167.8,28.43,276.3,47.46,124.4,22.68,148.8,27.17,74.2,15.12,34.4,8.43
12003 DATA 52.6,12.71,26.3,7.68,47.7,11.87,49.6,12.33,57.6,14.04,192.1,42.34
12004 DATA 136.4,32.22,221.2,51.14,188.9,44.42,141.4,34.56,71.8,19.45,36.6,10.77

```

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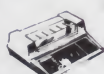
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HRZ-2D-64K	4495	3250
HDS-18 Hard Disc	5374	3890



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Mailmanager D/O	299	235
Infomanager D/O	499	365
General Ledger D/O	999	795
A/R D/O	599	475
A/P D/O	599	475



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TI-810 Full ASCII	1995	1580
TI-810 FLO/CP	2195	1760
TI-820 R/O BASIC	1995	1625
TI-820 KSR Package	2395	1950

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ADV-2Q-64K	3995	CALL
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PIO Board	200	CALL
FPB Board	399	CALL
Graphics Option	299	CALL



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Memory Option	150	150

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M26 Hard Disc	4495	3525
M20 Hard Disc	4795	3850



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	List	Sell
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D-Cat	199	150
Auto-Cat	249	190
Apple-Cat	389	310
DC Hayes Micro-100	379	330

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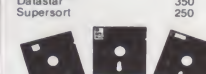
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Z-19 Terminal	995	750
Z-89 Computer	2895	2140
Z-90 Computer	3195	2490

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Datatar	350	250
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Listing continued.

```

12005 DATA 38.8,11.46,33.8,10.18,35.7,10.64,41.6,11.92,34.3,10.19,141.4,35.93
12006 DATA 219.2,55.82,216.4,51.75,137.6,35.79,110.3,27.72,19.20,40.6,11.28
12007 DATA 36.5,10.64,32.6,9.83,30.4,9.29,33.4,10.30,84.9,22.79,200.4,51.37
12008 DATA 249.4,64.78,163.4,48.82,108.4,35.4,55.22,03,30.7,16.02,52.8,21.76
12009 DATA 29.6,16.07,26.4,15.24,32.5,17.49,61.7,25.69,154.8,51.43,205.4,64
12010 DATA 250.78,81,246.2,78.02,103.6,39.23,40.5,20.61,32.6,17.99,49.2,22.60
12011 DATA 27.6,16.57,42.7,20.91,30.5,17.47,56.24,88,123.6,44.57,154.1,53.37
12012 DATA 217.73,62,239.2,80.37,108.3,41.02,44.5,21.03,27.7,15.38,49.9,21.44
12013 DATA 29.1,15.01,43,19.11,35.2,18.39,63.9,28.49,120.3,48.11,156.5,60.26
12014 DATA 212.9,84,195.7,78.17,102.5,45.08,39.5,21.35,33.5,18.91,43.6,22.79
12015 DATA 29.3,16.94,39.6,21.25,35.6,20.39,55.8,28.38,142.1,63.08,0,0
13000 REM HEATING AND COOLING DEGREE DAYS
13010 DATA 935,0,854,0,511,0,365,15,191,29,1,263
13020 DATA 0,344,0,376,24,173,221,19,524,0,852,0
13030 DATA 830,0,869,0,613,4,309,24,148,57,14,126
13040 DATA 0,361,0,317,49,130,303,8,509,11,759,0
13050 DATA 818,0,720,0,702,0,436,4,66,112,2,252
13060 DATA 0,351,0,404,50,85,156,27,397,10,853,0
13070 DATA 1050,0,603,1,518,0,293,58,133,51,11,315
13080 DATA 0,317,0,284,34,114,377,9,716,0,1001,0
13090 DATA 1296,0,790,0,469,10,245,37,62,124,18,217
13100 DATA 0,439,0,401,9,329,278,7,476,10,904,0
13110 DATA 1101,0,1048,0,715,0,318,0,141,63,9,260
13120 DATA 0,344,0,413,33,182,280,12,483,00,763,0
13130 DATA 984,0,1100,0,520,15,354,4,75,72,6,193
13140 DATA 2,348,3,351,22,145,311,28,425,1,757,0
13150 DATA 1080,0,766,0,712,0,364,0,134,24,2,278
13160 DATA 0,363,0,293,24,208,96,36,571,20,652,0

```

D(M) = yearly average of month's electricity usage (KWH)  
 M(M) = yearly average of month's heating fuel (Therm)  
 T(M) = 30 year average monthly temperature  
 A = exterior area of house in square feet  
 P(M,Y) = heating degree days for a given month of a year  
 Q(M,Y) = cooling degree days for a given month of a year  
 E(M,Y) = electrical energy (KWH) for a given month of a year  
 F(M,Y) = cost of electricity in dollars for one month  
 G(M,Y) = heating fuel (gal. if heating oil, Therms if natural gas) for a given month of a year  
 H(M,Y) = cost of heating fuel for a given month of a year in dollars  
 Y0 = starting year  
 Y1 = ending year  
 E1 = air conditioner efficiency (assumed 50 percent)  
 E2 = furnace efficiency (assumed 50 percent)  
 U = number of BTU/(degree \* hour \* square foot)  
 R = 1/U = effective R-value of house  
 W = graph scale multiplication factor

Table 2. Variable identities.

Sample run.

\*RUN

DO YOU HAVE ELECTRIC HEATING FOR YOUR HOME? (YES OR NO)?NO  
 DO YOU HAVE OIL HEATING FOR YOUR HOME? (YES OR NO)?NO

YEARLY COST OF UTILITIES (\$ DOLLARS )

YEAR	ELECTRICITY	NATURAL GAS	TOT. ENERGY	COST/DEG./DAY
1973	406.94999	94.869999	501.81999	.088084956
1974	591.59999	250.259999	841.85999	.154725233
1975	668.04999	282.87999	950.92999	.17464279
1976	670.91999	315.05999	985.97999	.167541205
1977	742.85999	398.72999	1141.58999	.186503838
1978	788.21999	435.02999	1223.24999	.19841849
1979	730.44999	442.22999	1172.67999	.205157451
1980	809.96999	420.33999	1230.30999	.218799572

U IS THE AVE. BTU/(DEG\*HR\*SQ.FT.). R = 1/U  
 T IS THE AVERAGE MONTHLY TEMPERATURE OVER 30 YEARS

	U	R	T
JAN	.128782699	7.7650181	32.699999
FEB	.167665786	5.964246	34.8
MAR	.142423688	7.0213038	43.3
APR	.174795641	5.7209664	53.899999
MAY	.269589761	3.7093396	63.199999
JUN	.243802851	4.1016747	72.199999
JLY	.194719424	5.1355944	76.699999

More

These values are useful if you are contemplating adding more insulation, or have just done so and wish to determine the cost-effectiveness of your work. The cost per degree per day shows the average of how much you can save each day by adjusting your thermostat one degree according to the season. The important point here is that the results reflect the way you actually live in your house.

## How It Works

The program is written in a version of BASIC that can be easily adapted to a variety of systems. In the BASIC version used here, the RESTORE statement must precede any data statement to initialize the pointers. Most versions in use today do not require this first initialization, and therefore it can be deleted from those programs.

Some constants unique to your house are required in the program. In line 142 the exterior surface area, A, is needed. The ground floor or basement floor area is not included unless there is a crawl space under the house. This area includes all walls and ceilings which face the exterior of the house; i.e., the surface area through which the heat flows to the outside.

Lines 148 and 149 contain the beginning and ending years for which the data is available. For example, if the data was only for 1980, then Y1 and Y0 would be the same, because the data is recorded from January to December. Lines 150 through 180 contain the string data necessary for the graphics plots. The key variables are identified in Table 2.

Next, the data statements are read in the proper format. The program expects first to read the 30-year monthly average temperatures, T(M), in lines 218 to 240. This is an optional feature which can be dropped since it serves only as a guideline in the printout at lines 941, 943, 970 and 1030. It is not used in the calculations, but was included here because it was available from the U.S. Weather Service. The data statements starting at line 10010 will be different for different areas around the country.

Data from your electric utility bill is then entered in the data statements beginning with line 11000. Monthly kilowatt hours (KWH) and cost are entered as pairs, starting with January of the first year. If this data is



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not available, enter zeros for the KWH and cost for each missing month. Don't skip any months! The year is concluded with December's values.

The heating utilities (natural gas or heating oil) are entered in the same way starting with line 12000. The units for natural gas are therms and the units for heating oil are gallons. A therm is 100,000 BTU, and is the basic unit on most bills. The electricity and heating utility data must begin and end with the same year. The program will select the proper conversion constants depending on whether you use oil or natural gas for heating. This is determined by lines 300 to 450.

The program asks if you use electricity, gas or oil as the source for your home heating. If electric heat is used, then lines 382 through 484 are skipped, and the gas or oil data statements are not used. If oil heat is selected, the data statements beginning with line 12000 must show monthly gallons and cost expended. If neither electric nor oil heat is selected, the program defaults to natural gas as the heating fuel. The

Sample run continued.

AUG	.202107243	4.9478681	75.5
SEP	.36261267	2.7577635	68.699999
OCT	.223375197	4.4767727	57
NOV	.157076413	6.3663281	46.199999
DEC	.139170444	7.1854337	36.6

THE AVERAGES FOR 1973 TO 1980 ARE:

U = .20051015

R = 4.9872786

T = 55.066666

AVE # HEATING DEGREE DAYS PER YEAR = 4526.875

AVE # COOLING DEGREE DAYS PER YEAR = 1234.75

DATA KEY:

+ = SINGLE DATA POINT  
\* = MULTIPLE DATA POINT  
# = MONTHLY AVERAGE  
< = BELOW RANGE  
> = ABOVE RANGE

#### ELECTRICITY USED PER MONTH

ELECT. (KWH X 10)	75	100	150	200	250	300
I	I	I	I	I	I	I
I	I	I	I	I	I	I
JAN	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
FEB	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
MAR	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
APR	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
MAY	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
JUN	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
JULY	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
AUG	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
SEP	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
OCT	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
NOV	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
DEC	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I

#### NATURAL GAS USED PER MONTH

GAS (THERMS X 1)	75	100	150	200	250	300
I	I	I	I	I	I	I
I	I	I	I	I	I	I
JAN	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
FEB	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
MAR	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
APR	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I
MAY	I	I	I	I	I	I
I	I	I	I	I	I	I
I	I	I	I	I	I	I

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Sample run continued.

```

JUN  I      *+#++
    I
    I
JUL  I      *#* +
    I
    I
    I
AUG  I      + *#+*
    I
    I
    I
SEP  I      **# + +
    I
    I
    I
OCT  I      + ++#++
    I
    I
    I
NOV  I      + + + +# ++ + +
    I
    I
    I
DEC  I      + * # + **
    I
    I
    I
    I-----I-----I-----I-----I-----I-----I-----I-----I-----I

```

TOT. ENERGY USED PER MONTH

```

ENERGY (KWH X 50)  75   100   150   200   250   300
JAN  I-----I-----I-----I-----I-----I-----I-----I-----I
    I      + + #++ ++
    I
    I
    I
FEB  I      + + #+ ++ +
    I
    I
    I
    I

```

More

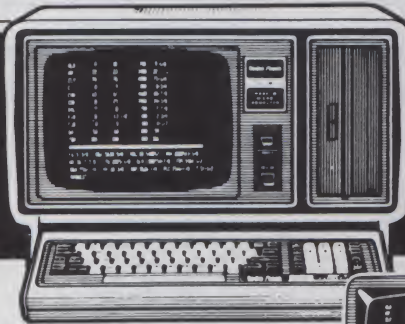
data statements must then contain the monthly therms and cost.

You must be sure when you enter the energy values from your utility bills that they correspond to the month the energy was used and not when the bill came due. This must be done to correlate energy consumption with the degree days for each month. Otherwise, there will be a skew in the graphs.

The final data needed is the heating and cooling degree days in each year for which utility bills are known. Starting with January, the heating and cooling degree days are entered as monthly pairs at line 13000. Enter heating then cooling for each month in the data statements (e.g., Jan. 1973: 935, 0).

M and Y are the month and year indices. The function in line 310 is used to reduce the year to a single digit for use in the FOR loop and in the two-dimensional arrays.

E1 and E2 in lines 954 and 955 are the efficiencies of the air conditioner and furnace. I assigned a reasonable approximation of 50 percent to each. If you have a more accurate value, use it. In lines 8910 and 8950 the



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scale factor W is specified for the five graphs. You may want to raise or lower these values, depending on the

maximum utility value for any given month. The scale marking for each month is graduated from 0 to 325. W

determines the multiplication factor that is used with this scale. In the sample run for the total energy used in the month of January, a data point occurs at the scale value of 100. The scale factor is 50 for this graph, so the data point represents total energy consumption of 5000 KWH.

Index I steps through the five graphs and determines the proper string variable lengths to be used in each plot. In line 9105 the values L and O are the respective minimum values for electricity and heating fuel. They are assumed to be the monthly operating conditions for the house without heating or cooling energy loads. L and O are arbitrarily set to a high value (i.e., 10,000). Lines 9107 and 9108 then choose the minimum nonzero values for L and O, respectively, from the data.

There is some question as to the merit of this assumption. The concept of the degree day is based on the fact that the inside temperature is assumed to be 70 degrees F, while degree days are determined based on 65 degrees F exterior temperature. Daily energy consumption, excluding heating or cooling, produces heat

Sample run continued.

```

MAR  I  +          +### +   +
      I
      I
      I
APR  I  +    * +#    +   ++
      I
      I
      I
MAY  I      ** #    * +
      I
      I
      I
JUN  I      # * +
      I
      I
      I
JLY  I      + + +##**
      I
      I
      I
AUG  I          ###
      I
      I
      I
SEP  I      +  +## +   +
      I
      I
      I
OCT  I      +##*
      I
      I
      I
NOV  I      + + + # ++ ++
      I
      I
      I
DEC  I  +          + #   +++
      I
      I
      I
I---I---I---I---I---I---I---I---I---I---I---I---I---I---I---I

```

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from appliances or lighting along with the solar energy absorbed.

If your version of BASIC cannot handle the double IF statements in line 8920, 8922, 9107 or 9108, then you can divide it into two or more lines each.

The graphs are constructed using the string variable D\$, which is initially set to blanks for each line. Positions in the string are then assigned in lines 9150 through 9200 for the corresponding data points. This technique is often used with Teletype-based printers. This type of string handling lends itself nicely to this approach, but other string-handling systems can be modified to accomplish the same effect. See, for example, "Strings and Things: BASIC Conversion Techniques," by Richard Roth, *Kilobaud Microcomputing*, May 1978, pp. 94-98.

### Conclusions

Although this is a rough cut at the energy efficiency of a house, it is remarkably accurate during peak heating and cooling months. There are a number of excellent pamphlets, bro-

Sample run continued.

		DEGREE DAYS USED PER MONTH						
HEAT+COOL(D.D.X 10)		75	100	150	200	250	300	
JAN	I	I	I	I	I	I	I	I
	I		++	++	+			
	I							
	I							
	I							
FEB	I		+	++	++			
	I							
	I							
	I							
	I							
MAR	I		++	+				
	I							
	I							
	I							
	I							
APR	I		++	++				
	I							
	I							
	I							
	I							
MAY	I		++					
	I							
	I							
	I							
	I							
JUN	I		++	++				
	I							
	I							
	I							
	I							
JULY	I		++	+				
	I							
	I							
	I							
	I							
AUG	I		++	++				
	I							
	I							
	I							
	I							
SEP	I		++	+				
	I							
	I							
	I							
	I							
OCT	I		++	++	++			
	I							
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	I							
	I							

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NOV I            ++ # + +  
I  
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DEC I  
I                 + \* # \* + +  
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I-----I-----I-----I-----I-----I-----I-----I-----I-----I-----I-----I-----

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[illegible]

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*Money-Saving Guide to Energy in the Home* by Consumer Reports. Doubleday and Co., Garden City, NY, 1978.  
*How to Do Your Own Home Insulation* by L. Donald Meyers. Harper and Row, New York, 1978.

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# Printing Wizardry For Your Sorcerer

By Ernest E. Bergmann

**W**hen I found that most printers cost almost as much as my Exidy Sorcerer, I bought an inexpensive old Teletype Model 33. The hardware, although not elegant, works (see schematic). And the software is useful even without a printer, letting you stop or slow the listing whenever you want.

The software for the interface had to meet several criteria.

First, it had to be a patch to my I/O drivers so that it would automatically be usable with BASIC or the development ROM Pac.

Second, it had to be small enough to fit in RAM below 100H.

Third, it needed to use the control code conventions of CP/M; control-P would turn on and off the printing and control-S would halt output. Another key would let the output resume.

Fourth, because the character set of the Model 33 printer is limited, all lowercase letters routed to the printer had to be converted to uppercase.

Finally, the program had to be clear and easy to modify for future needs, such as other printers and baud rates.

## The I/O Patches

It is good programming to provide patch points for all of the I/O drivers, so that you can make changes without too much fuss.

You need to replace the original

calls to the Sorcerer's keyboard with calls to your substitute routine, which behaves just like the original routine except that it filters out control-P for special action.

Also, you must replace the Sorcerer's original video routine with the new output routine. This new routine not only displays output on the video screen, but also drives the printer, and checks the keyboard for a control-S and takes the appropriate action when one occurs.

To substitute in our two I/O routines (CHIN and CHOUT) when using the Sorcerer's monitor, you can use the commands >SET I=50 and >SET O=5B. Or, to make life a bit easier, you can execute IOINIT (location 2AH in RAM, line 30 in the listing). This initialization routine calculates the locations in the monitor work area (MWA), where the addresses for CHIN and CHOUT must be placed, and then performs the two patches.

## The Initialization Routine

IOINIT works properly with machine code programs that call the monitor's RECEIVE input routine at E009H and the monitor's SEND output routine at 0E00CH. These requirements are innocuous enough for assembly-language user programs, and are met by the BASIC ROM PAC.

Also, a little detective work establishes that everything is all right in the Development ROM PAC; the I/O drivers, :SK and :SK, which are described on page 17 of the user's man-

ual as the Sorcerer Keyboard and Sorcerer Video Screen, are actually using the monitor's RECEIVE and SEND. You must beware of one potential problem: the Development PAC must be able to place a jump instruction at the RST 7 location, 38H, which is in the area where the IOINIT routine resides. After a little fitting with a relative jump instruction, you free up these critical three bytes.

This is how you can find (and the way IOINIT finds) the proper location for the patches: the memory locations, 0F000H and 0F001H contain the value of the highest RAM address, which, of course, depends upon the particular computer configuration. By subtracting 6EH from (by adding 0FF92H to) this address you find the base address of the monitor work area (MWA). According to the Exidy documentation, MWA+3FH and MWA+40H should contain the address of the routine used by SEND, and MWA+41H and MWA+42H contain the address used by RECEIVE.

Once the IOINIT routine performs its patches, it is no longer needed and can be overwritten to make use of all the RST locations.

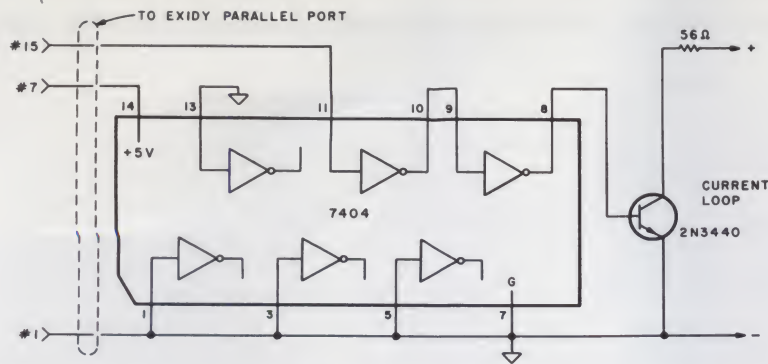
## The Input Routine

You require of the character input routine, CHIN, that if no key is pressed, it should return immediately with the Z flag set. If a key is pressed, the original KEYBRD routine waits until the key is released, and then returns with the ASCII value of the character in the A register

---

*Address correspondence to Ernest E. Bergmann, Physics Department, Building 16, Lehigh University, Bethlehem, PA 18015.*





Schematic of circuit used to convert the TTI<sub>1</sub> signals from one of the pins of the computer's output port to the active 60 mA (and 75 V) loop of the particular ASR33 unit the author has.

and the Z flag reset.

Similarly, CHIN would return when the key is released, except when a control-P has been entered. If this particular character has been typed, CHIN complements the variable STATE (used to control output to the printer) and CHIN reenters itself to get whatever follows the control-P. Thus, the calling program never is aware that a control-P was ever entered from the keyboard. The CHIN routine resides in lines 56-70.

### The Output Routine

Let's turn our attention now to the character output routine, CHOUT. On entry (line 77 in the listing), CHOUT calls CTRLS, a routine which looks for a control-S from the keyboard (which will be described later).

Next (starting in line 78), CHOUT checks the value of STATE to see whether the printer should be sent any output. If STATE is zero, no action is taken and control is passed to the Sorcerer monitor's VIDEO at 0E01BH. Otherwise, CHOUT must send appropriate signals to the printer. The PRINT routine gets the character to the "primitive" typewriter output routine, PTYO, and then exits to the Sorcerer's VIDEO; PRINT ensures that the contents or registers are saved.

PTYO (starting at line 90) does most of the actual work, but it is not concerned with protecting the original contents of registers (that was PRINT's job). Since the Model 33 printer cannot produce symbols corresponding to ASCII codes higher than the character z, it doesn't try (it simply returns). The ASCII character 60H ('), just before a, looks almost like a single quote or apostrophe, ASCII 27H ('; you make the printer print the substitute. Between 60H and z+1 you have the lowercase al-

phabet; since the printer has only uppercase type, you subtract 20H to convert it to uppercase.

You are almost ready to send the character to the printer, except that there are three control codes to which the printer should respond that require special handling. The line feed and carriage return characters take extra time to perform. The routines LF and CR provide extra time, which is adjusted by the value of WAIT; I picked a value which appears to work. It probably depends upon the lubrication in the printer mechanism, so you can change the value of WAIT easily.

A popular control code with the Exidy is control-L, the form feed charac-

ter, which clears the screen. To keep things simple, I have implemented a reasonable facsimile with a carriage return followed by a number (FFSIZE) of line feeds.

After filtering out these three special control codes, we continue down to UART (line 112), which transmits the character to the printer.

### The Software UART

To operate at 110 baud, I implemented a software UART. The hardware UART of the Sorcerer, which is already overused in the cassette and RS-232 interface, only operates at 300 and 1200 baud. The UART must send out a serial stream of binary data. At 110 baud, the time interval associated with each bit of data is 9.09 ms.

For current loop operation: when current is permitted to flow in the circuit, you call it the mark condition; when current cannot flow, you have a space condition. The mark and space conditions correspond to a binary 1 and 0, respectively. In asynchronous transmission, the pause or gap between characters should be mark.

When an individual character is sent, its contents are preceded by a start pulse (line 114), which consists of 9.09 ms of space. The next eight time intervals contain a mixture of marks and spaces, in accordance with

Program listing. Exidy assembly-language program to interface the Teletype Model 33.

```

EXIDY Z-80 ASSEMBLER
ADDR  OBJECT  ST
0001
0002 ;
0003 ;*****
0004 ;*
0005 ;*      SIMPLE INTERFACE FOR ASR33
0006 ;*      by E.E. Bersmann
0007 ;*      JANUARY 4, 1981
0008 ;*
0009 ;*****
0010      PSECT   ABS
0011 ;
0012 FFSIZE EQU    5
0013 KEYPRT EQU    0FEH
0014 PPORT EQU    0FFH      ;EXIDY PARALLEL PORT
0015 KEYBRD EQU    0E01BH
0016 ;
0017 ;
0018 ;*** OPTIONAL: *****
0019 ;*
0020 ;*      IOINIT IS OPTIONAL SINCE
0021 ;* ONE CAN USE THE MONITOR
0022 ;* COMMAND, "SET I=,0=",ETC.
0023 ;*
0024 ;* IT IS A CONVENIENCE IF ONE
0025 ;* DOES NOT USE THE RST AREA
0026 ;*
0027 ;*****
0028      ORG      2AH
0029      GLOBAL  IOINIT
0030 IOINIT  PUSH    DE
0031        PUSH    HL
0032        LD      HL,(0F000H)
0033        LD      DE,0FF92H+3FH
002A D5
002B E5
002C 2A00F0
002F 11D1FF

```

More



the bit pattern of the byte that is being sent. This software UART sends two more intervals of mark (two stop pulses); the first stop pulse is the ninth and last pass through ULOOP, since, originally, the carry flag was set (line 116). The second stop pulse is created by jumping from ULOOP to MARK+2 (line 122).

The space and mark intervals are generated by the routines SPACE and MARK. They share a common timing loop, DELAY, where the time interval is controlled by the value of the variable PAUSE (introduced in line 88).

## The CTRLS Routine

Lastly, I'll describe CTRLS (starting at line 170), which looks for and handles control-S; it is called from the beginning of CHOUT.

To find out if a control-S is pressed, it is not necessary to scan the whole keyboard, such as is performed by the monitor routine KEYBRD. A very limited scan is done by sending 3 to the keyboard port (KEYPRT) and inputting from that same port, testing only bit 2 (lines 171-174); if this bit is zero, the S key is pressed. The routine then looks to see if the CTRL key is also pressed (lines 178-181).

If these keys are not both pressed, then CTRLS returns without doing anything. However, if the control-S combination is pressed, you end up at YES (line 185). YES will scan the keyboard repeatedly until the keys are released before we get to K2 (line 187). K2 waits until another character is typed; while it is waiting, the listing has stopped and you can examine the display at your leisure. The listing resumes when you type that second character that K2 expects. Because K2 uses CHIN (line 187), you can turn the printer on or off with a control-P.

## Conclusion

This package has given me great pleasure. It is useful even without the printer because the listing can be stopped or slowed whenever you want. With the printer you may abstract, letting the listing fly by until the portion of interest is reached. Pressing control-S stops the display; pressing control-P readies the printer; and pressing any key restarts/resumes the listing, this time with the printer engaged. When the printout becomes uninteresting, use control-S, control-P and any key to stop the listing, disengage the printer and resume high-speed CRT display. ■

Listing continued.

```

0032 19          0034          ADD    HL,DE
0033 115B00      0035          LD     DE,CHOUT
0036 1803        0036          JR     RST7+3-$
                0037 ;
                0038          ORG    3BH      ;RST 7 LOCATION
003B C3A3C0      0039 RST7    JP     0C0A3H  ;USED BY DDT
                0040 ;
003B 73          0041          LD     (HL),E
003C 23          0042          INC    HL
003D 72          0043          LD     (HL),D
003E 23          0044          INC    HL
003F 115000      0045          LD     DE,CHIN
0042 73          0046          LD     (HL),E
0043 23          0047          INC    HL
0044 72          0048          LD     (HL),D
0045 E1          0049          POP    HL
0046 D1          0050          POP    DE
0047 C9          0051          RET
                0052 ;*** END OF (OPTIONAL) IOINIT ***
                0053 ;*****
0054 ;
0055 ;
0056 ;*** CHARACTER INPUT ROUTINE: ***
0057 ;
0058          GLOBAL CHIN
0059 ;
004B 3A6900      0060 YEP     LD     A,(STATE)      ;FLIP STATE
004B 2F          0061          CPL
004C 326900      0062          LD     (STATE),A
004F F1          0063          POP    AF
0050 CD18E0      0064 CHIN    CALL  KEYBRD
0053 C8          0065          RET     Z          ;NO CHAR YET
0054 F5          0066          PUSH   AF
0055 FE10        0067          CP     10H      ;CTRL-P?
0057 28EF        0068          JR     Z,YEP-$
0059 F1          0069          POP    AF
005A C9          0070          RET
                0071 ;
                0072 ;
0073 ;*** CHARACTER OUTPUT ROUTINE: **
0074 ;
0075          GLOBAL CHOUT
0076 ;
005B CDD800      0077 CHOUT   CALL  CTRLS
005E F5          0078          PUSH   AF
005F 3A6900      0079          LD     A,(STATE)
0062 A7          0080          AND     A
0063 2009        0081          JR     NZ,PRINT-$
0065 F1          0082 TOVID   POP    AF          ;TO VID IN
0066 C318E0      0083          JP     0E01BH  ;MONITOR
                0084 ;
0085 ;*** SYSTEM VARIABLES: *****
0086 ;
0069 00          0087 STATE   DEFB    0          ;0=NO PRINT
006A B004        0088 PAUSE   DEFW    04B0H      ;110 BAUD
006C 401F        0089 WAIT    DEFW    B000        ;CR _LF
                0090 ;
006E F1          0091 PRINT   POP    AF
006F F5          0092          PUSH   AF
0070 E5          0093          PUSH   HL
0071 CD7900      0094          CALL  PTYO
0074 E1          0095          POP    HL
0075 18EE        0096          JR     TOVID-$
                0097 ;
0077 3E27        0098 APOSTR   LD     A,27H      ;APOSTROPHE
0079 FE7B        0099 PTYO    CP     'z'+1      ;REGS DESTROYED
007B D0          0100          RET     NC
007C FE60        0101          CP     60H
007E 28F7        0102          JR     Z,APOSTR-$
0080 3802        0103          JR     C,NOTLC-$
0082 D620        0104          SUB    20H      ;LC -> UC
0084 FE0A        0105 NOTLC   CP     0AH
0086 2835        0106          JR     Z,LF-$
0088 FE0D        0107          CP     0DH
008A 283D        0108          JR     Z,CR-$
008C FE0C        0109          CP     0CH      ;"CLEAR SCREEN"
008E 283E        0110          JR     Z,FF-$
                0111 ;
0090 F5          0112 UART    PUSH   AF
0091 E5          0113          PUSH   HL
0092 CDA400      0114          CALL  SPACE
0095 2E09        0115          LD     L,9
0097 37          0116          SCF
0098 1F          0117 ULOOP   RRA
0099 DCA900      0118          CALL  C,MARK
009C D4A400      0119          CALL  NC,SPACE
009F 2D          0120          DEC    L
00A0 20F6        0121          JR     NZ,ULOOP-$

```

More



Listing continued.

```

00A2 1807      0122      JR      MARK+2-$
               0123 ;
00A4 F5        0124 SPACE  PUSH    AF      ; 'ZERO'
00A5 AF        0125      XOR      A
00A6 D3FF      0126      OUT     (PPORT),A
00A8 F1        0127      POP     AF
00A9 F5        0128 MARK   PUSH    AF      ; 'ONE'
00AA E5        0129      PUSH    HL
00AB 2A6A00    0130      LD      HL,(PAUSE)
00AE 23        0131 DELAY  INC     HL
00AF 24        0132      INC     H
00B0 2D        0133 DLOOP  DEC     L
00B1 20FD      0134      JR      NZ,DLOOP-$
00B3 25        0135      DEC     H
00B4 20FA      0136      JR      NZ,DLOOP-$
00B6 3EFF      0137      LD      A,OFFH
00B8 D3FF      0138      OUT     (PPORT),A
00BA E1        0139      POP     HL
00BB F1        0140      POP     AF
00BC C9        0141      RET
               0142 ;
00BD F5        0143 LF     PUSH    AF      ;LINEFEED
00BE 3E0A      0144      LD      A,0AH
00C0 CD9000    0145 UARTW  CALL    UART  ;UART+DELAY
00C3 E5        0146      PUSH    HL
00C4 2A6C00    0147      LD      HL,(WAIT)
00C7 18E5      0148      JR      DELAY-$
00C9 F5        0149 CR     PUSH    AF      ;CARRIAGE
00CA 3E0D      0150      LD      A,0DH  ;RETURN
00CC 18F2      0151      JR      UARTW-$
               0152 ;
               0153      ;FORMFEED
00CE CDC900    0154 FF     CALL    CR      ;LEAVES FFSIZE OF
00D1 C5        0155      PUSH    BC      ;BLANK LINES ON PRINT
00D2 0605      0156      LD      B,FFSIZE
00D4 CDE000    0157 FFLOOP  CALL    LF
00D7 10FB      0158      DJNZ    FFLOOP-$
00D9 C1        0159      POP     BC
00DA C9        0160      RET
               0161 ;
0162 ;***** CTRLS: *****
0163 ;*
0164 ;*      CHECKS TO SEE IF CTRL-S *
0165 ;* IS PRESSED. IF SO, IT WAITS *
0166 ;* UNTIL A SECOND KEY IS PRESSED*
0167 ;*
0168 ;*****
0169 ;
00DB F5        0170 CTRLS  PUSH    AF
00DC 3E03      0171      LD      A,3
00DE D3FE      0172      OUT     (KEYPT),A
00E0 DBFE      0173      IN      A,(KEYPT)
00E2 E604      0174      AND     4
00E4 2802      0175      JR      Z,CTRLQ-$
00E6 F1        0176      POP     AF
00E7 C9        0177      RET
00E8 3E00      0178 CTRLQ  LD      A,0      ;CTRL PRESSED?
00EA D3FE      0179      OUT     (KEYPT),A
00EC DBFE      0180      IN      A,(KEYPT)
00EE E604      0181      AND     4
00F0 2802      0182      JR      Z,YES-$
00F2 F1        0183      POP     AF
00F3 C9        0184      RET
00F4 CD18E0    0185 YES    CALL    KEYBRD ;BOTH KEYS PRESSED
00F7 28FB      0186      JR      Z,YES-$
00F9 CD5000    0187 K2     CALL    CHIN  ;ENABLE OPERATOR TO
00FC 28FB      0188      JR      Z,K2-$  ;CHANGE PRINT STATE
00FE F1        0189      POP     AF
00FF C9        0190      RET
               0191 ;
0192 ;*****
0193 ;* END SHOULD NOT *
0194 ;*      OVERWRITE 100H *
0195 ;*****
0196 ;

ERRORS=0000
APOSTR      0077 CHIN  [INT] 0050 CHOUT [INT] 005B
CR           00C9 CTRLQ      00E8 CTRLS      00DB
DELAY       00AE DLOOP      00B0 FF          00CE
FFLOOP      00D4 FFSIZE     0005 I0INIT [INT] 002A
K2          00F9 KEYBRD     E018 KEYPT      00FE
LF          00BD MARK       00A9 NOTLC      00B4
PAUSE       006A PPORT      00FF PRINT      006E
PTYD        0079 RST7       0038 SPACE      00A4
STATE       0069 T0VID      0065 UART       0090
UARTW       00C0 ULDP       009B WAIT       006C
YEP         004B YES        00F4

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# Data Capture: Who Needs It?

By David Goodfellow

**D**ata Capture 4.0, by Southeastern Software, is advertised as "the most advanced and easiest to use telecommunications program for use with the Micromodem II or the Apple Communications card." After using the program for several weeks, I have no reason to doubt it.

Of course, it isn't necessary. When I want my Apple to talk with another computer, I can always access my modem directly by typing in the appropriate commands. I can read fast when the other computer is sending, or connect directly to my printer. I can give the other guy sloppy input by typing directly to him. And I can let my Source charges pile up while I read my mail or try to send some. No, Data Capture 4.0 isn't necessary at all.

But boy, does it make things easy. Data Capture 4.0 requires a 48K Apple II with at least one disk drive using 3.2, 3.2.1 or 3.3 DOS. With it you can:

- Prepare messages off-line and squirt them through the phone at 110 or 300 baud—a lot faster than I can type.
- Take down all incoming data at either baud rate to read later at your convenience—no more eye-strain as the information scrolls off the top of the screen.
- Save that data to disk for later use—either to print or view on the monitor, at your own reading speed.
- Upload or download Applesoft or Integer programs as text files—which are easily converted back to their original program state with EXEC.
- Use a number of "special characters" which are not normally acces-

sible to the Apple II—underline, left square bracket, back slash, vertical bar, left and right curly brackets.

Data Capture is sold as a single disk, with 24 solid 8-1/2 × 11-inch pages of documentation. The manual (and the program itself) practically begs you to make backup copies, and gives step-by-step instructions on how to do this. It then tells you how to configure one of your backups to your system, and how to copy your *configured* backup. If you follow all of the instructions, you'll wind up with four disks—two unconfigured, and two configured. Unless you stack them all together and drive a stake through their hearts, you should never be without a usable copy.

Booting a configured Data Capture disk brings up a blank screen with four status lines at the top. More about these later. Press escape and the master menu is displayed, inviting you to select one of the following features:

*List Text*—This displays whatever you have in the capture buffer—whether you typed it yourself, accessed it from a text file or received it via telecommunications. The buffer is line-oriented (up to 500 lines), and you can start your list from any line, stop the listing to view the screen and then continue, or exit the listing feature at any time.

*Delete Text*—This allows you to delete any part (or all) of the material in the capture buffer. It's used for editing, and for clearing the buffer.

*Insert Text*—This lets you insert up to ten lines of text at a time anywhere within the text in the buffer. If ten lines isn't enough, you can do it again—and again. The program asks

the line number you wish the insert to precede, and displays that line for reference while you enter the new text. This function, with Delete Text, provides sufficient editing capabilities to massage the text any way you wish. It's not as fancy as most word processing programs, but it does the job.

*Send Text*—Send Text is used when you're on line with another system. Escape to the menu and hit S. The program asks you a starting and ending line number to send; when you give it these numbers, the text is on its way. Or press A for all, and all the text in the buffer goes.

*Print Text*—Print Text sends the contents of the buffer to the printer, with the same choices as mentioned in Send Text.

*Write to File*—This feature writes the entire contents of the buffer to a text file on disk, under any name you choose. If you choose a name that already exists on the disk, it will tell you so and ask if you wish to overwrite it. If not, you can escape and try again, using another file name.

Note that this feature is automatic if you have allowed the buffer to fill up. In this case, the program writes the contents to disk under the name "Overflow" "-1," "-2," etc. If you already had an "Overflow-1" on the disk from a previous session, you've lost it. This would be considered a pilot error—not the program's fault.

*Merge from File*—This reads the contents of any text file you name from disk to buffer.

*Catalog Disk*—I most often use this with Merge from File—mainly be-

---

Address correspondence to David C. Goodfellow, PO Box 66834, Seattle, WA 98166.



cause I can never remember the name I used to write to file.

**Enter Phone Number**—This is used with the Micromodem only. The program asks you to type in the phone number desired, and after giving you a chance to verify it, calls the number. If you are using The Source and have configured Data Capture 4.0 to use the function, you may type S for the phone number and the program will call in and log on for you.

**Hang Up Phone**—Micromodem only. Hangs up phone.

**Await Call**—Micromodem only. This lets you set up the computer for remote access. The computer expects another computer. "If a man answers, hang up."

**Quit Program**—Soft exit. You can quit the program through this selection without losing anything in memory. This allows you to catalog the disk and delete, rename or otherwise fiddle with your files. GOTO 1000, and you're back in business. Or, you can quit for good.

**Toggle**—This feature presents a separate menu of two-state functions which can be switched back and forth. These functions are:

- **Alternate Drive (1 or 2)**. With this you can write, read or catalog on either drive. Default value is 1. I like to use drive 2 for text files, so I don't fill up the disk the program is on. Of course, the whole program is in memory, so single-drive users can simply replace the program disk with an initialized data disk.
- **Baud Rate (110/300)**. Set as required.
- **Capture (on/off)**. Extremely valuable. With this you can avoid capturing information you know you won't want to keep—such as introductory lines of bulletin board systems, etc.; then you can turn the function on when you're ready to receive the information you're after.
- **Duplex (full/half)**. Use half duplex when off-line, and full when communicating with those systems that need it.
- **Local Carrier (on/off)**. Micromodem only. This is useful when two Apple owners wish to suspend computer communications and talk by voice.
- **Special Characters (on/off)**. This function, when on, lets the Apple use certain characters which are not normally available to it. For instance, I used the underline a few days ago to delete a file in The

Source that was put in by an ex-user of my account. The file was sitting in there running up the bill, with the underline character part of the file name. The Source customer service could have taken it out for me, but it's much more satisfying (and certain) when you do it yourself.

- **Transmit (on/off)**. You can use this function while on-line to type something into your buffer without sending it to the other station.

When not in the master menu, the screen is clear except for the contents of the capture buffer and the status lines at the top of the screen. These lines show the state of the toggle functions, plus one other indicator, Lines. This function does not toggle. It merely tells you how many lines of

When the program comes up, you press escape for the menu, E for enter, and S for Source. The program displays your local Telenet or Tymnet phone number and asks if it's correct (it always is, if you entered it right the first time). You press Y for yes, and Data Capture takes it from there, dialing in and logging on for you.

When The Source comes on you go directly to MAIL, READ, and sip your coffee or something else while your mail is being dumped at 110 or 300 baud. You don't take notes. You don't risk eyestrain or mental fatigue trying to keep up with your mail while it scrolls off the screen. When all your mail is in, you type quit, then off. The Source logs you off, after which you hit escape and select H

---

You dump the mail to your printer

or to disk for later viewing.

If you don't have a printer,  
you can reread the mail through the display  
as often as you wish.

---

text you have in your buffer. When it nears 500, you know you had better transfer it to disk—or the program will do it for you. This is useful when you wish to download a program which you know will take most of the buffer. It helps you make the judgment.

Note that every function on the menu is available to you even while you are on line. When you press escape to go to the menu, Data Capture sends a stop code (CTRL-S) recognized by most remote services, so that incoming data is not lost while you choose a function. Resume operation with whatever code the other system recognizes—usually any key, return or CTRL-Q.

Let's say you're carrying on a correspondence with Source (or other timeshare system) users. Your last bill almost did in the family Lord Exchequer and you have to cut the costs or sell Aunt Minnie's diamonds to stay solvent. Since Aunt Minnie's bigger than you are, the latter solution is dangerous.

Enter Data Capture 4.0.

You place into your disk drive a disk which you have configured according to explicit instructions in the documentation, and "PR#6" it.

(hang up) from the menu.

Then, on your own time (the meter's not running anymore), you dump the mail to your printer or to disk for later viewing. If you don't have a printer, you can reread the mail through the display as often as you wish.

Still off-line, you answer each piece of mail by typing it into Data Capture, using the program's delete and insert features to edit what you've done. When all your mail is answered, you jump back into The Source and send it—faster and more accurately than you could have typed it on-line.

The two Source sessions together cost a lot less than if you had done it manually in one session. Aunt Minnie's diamonds are safe!

Just for fun the other night I took (downloaded) an Apple program from a public access file belonging to another user of The Source. The other user had left it as a text file for that purpose. Data Capture took it easily, and on command dumped it to disk. I then exited Data Capture and went to Integer—still in DOS.

With the command EXEC RANDOM SENTENCES, I brought it into memory as the Integer program it was, then rewrote it to disk with



SAVE RNDM SENTENCES. Not needing the text file any more, I typed DELETE RANDOM SENTENCES. That's all there was to it! RNDM SENTENCES is available to me whenever I want it, and it runs beautifully.

You can send Applesoft or Integer programs just as easily, by converting them to text files with the program called (appropriately) CREATE.TXT, and included on the disk. The only requirement for any data to be uploaded or downloaded is that it be formatted as a text file.

Occasionally, I like to advertise a certain product or service in bulletin board systems across the country. I look forward to trying it with this program, because last time I did it (manually) the long distance charges just about cancelled the profits—and my ads didn't look that great because it's hard for me to type and proof copy with the knowledge that Ma Bell's meter is ticking.

With Data Capture 4.0, I'll prepare the ad off-line, and when it's done to my satisfaction, I'll go down the list of bulletin boards, call each in turn, squirt my message at it, and hang

up—hit and run. Each call will be under three minutes, and I'm betting that my phone bill will be considerably less than when I did it manually.

No, Data Capture 4.0 isn't necessary. But if you're into telecommunications, it takes away most of the drudgery and shuts off the meter a lot quicker. Isn't that what computers are all about—automating the drudgery jobs and cutting costs?

There are some things I'd like changed. For instance, timeshare systems like The Source operate full-duplex. This means that the system echoes back to your Apple everything you send, character-by-character (invisibly, of course). The program handles this all right, except for line feeds. Every time you press return you get two—one from your keyboard and one from the echo. This can fill the buffer pretty fast.

I'd like to see the program made compatible with some of the other modems hitting the market. Many bulletin boards support 600 baud and faster. When you're operating long distance, faster is cheaper.

I suppose that the send routine

could be speeded up a little if it didn't have to wait for the echo of each character sent. But speeding it up in this way may not be a good idea. I think I prefer the confirming echo.

Every day it becomes harder to find major faults with Apple software that is being sold successfully. A couple of years ago users were happy with a program which could play a reasonable game of tic-tac-toe without crashing every third game. Now, programs are more sophisticated and distributors more critical. The result is software that is user-oriented, relatively crash-proof, and very, very useful or entertaining. Programs that aren't just don't make it. This one made it.

Data Capture 4.0 is probably available at your local computer store, listing for \$65. If you can't find it there, try Southeastern Software, 6414 Derbyshire Drive, New Orleans, LA 70126. Owners of the previous version, Data Capture 3.0, can upgrade by sending in their old disk and documentation, plus \$37.50. The program is written in Applesoft and machine language, and supports the Paymar lowercase adapter. ■

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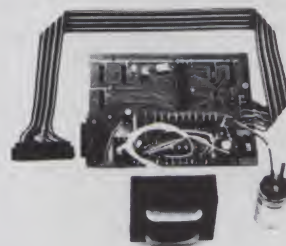
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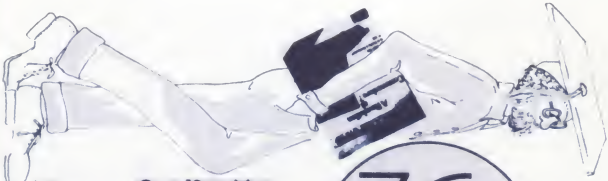
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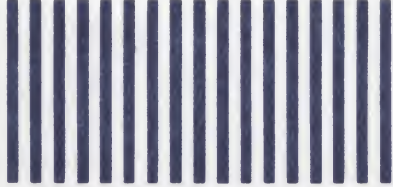
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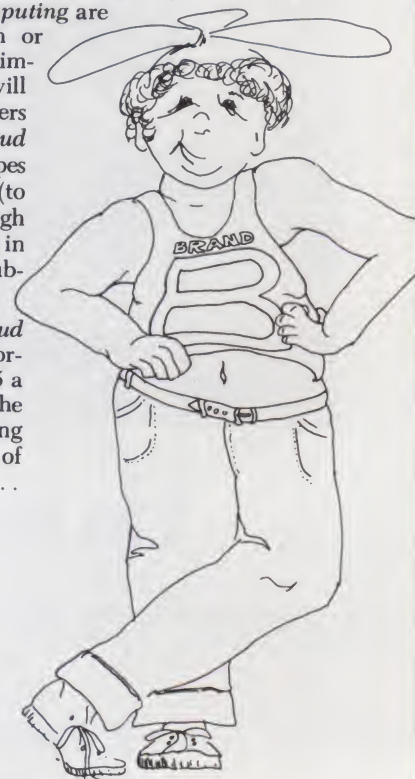
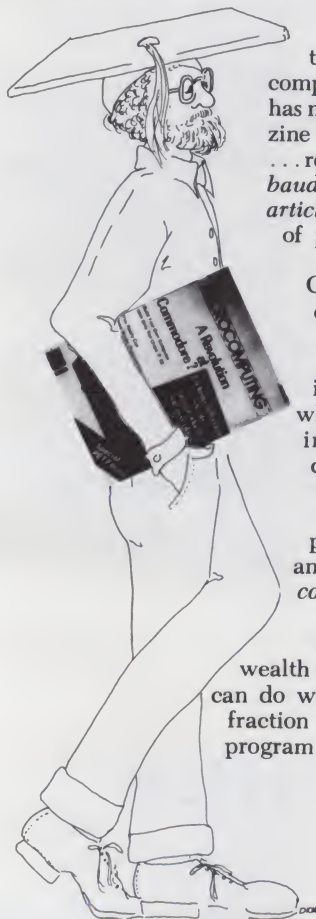
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# IBM Thinks Small

By G. Michael Vose

**H**undreds of thousands of Americans have seen an IBM computer in their local bank or at the office where they work. IBM means computers to many people. Therefore, a Personal Computer with the name IBM on it will sell a million, right?

Perhaps not. The new IBM Personal Computer will be a solid investment for anyone who needs a computer, but it is, above all, a computer. Not everyone needs or wants a computer—some people are even anti-computer. But it would seem, based upon a look at the Personal Computer, that IBM has, at least, done everything right while making its first truly personal computer.

## The Right Combination

The executives at IBM apparently used this formula in developing the Personal Computer: Make it expandable for the future. Make it compatible with existing software. Make it attractive. And make it easy to use.

It is hard to imagine how you could go wrong with this formula, and it would be a safe bet that IBM will succeed in selling many Personal Computers in the years ahead: not simply because of the name IBM, but because the company has obviously learned a great deal from other manufacturers' mistakes.

The instruction manuals are the first clue. IBM has used its vast corporate resources and a well-trained staff of technical writers to prepare



*The IBM Personal Computer with video display, two disk drives and 80-column printer.*

the most thorough, easy-to-understand instruction manuals I've ever seen. I would even hesitate to call these manuals documentation, because they are so well written they don't seem to fit into that category; typically, documentation is stilted in style and full of awkward conventions.

The Personal Computer comes with four manuals (if configured for disk operation), a BASIC language manual, a disk-operating system manual, a manual on setting up the computer, and a separate manual describing all the additional peripherals and the software you can buy. A fifth

manual will become available soon, for an extra \$150, containing the technical and repair information for the system.

These manuals are remarkably free of jargon, at least until you are ready for some, and are bound in hardcover 6 by 9 inch three-ring binders.

The Personal Computer looks good. The keyboard, system unit and video display are housed in separate boxes attached to one another by cables. This modular design gives the

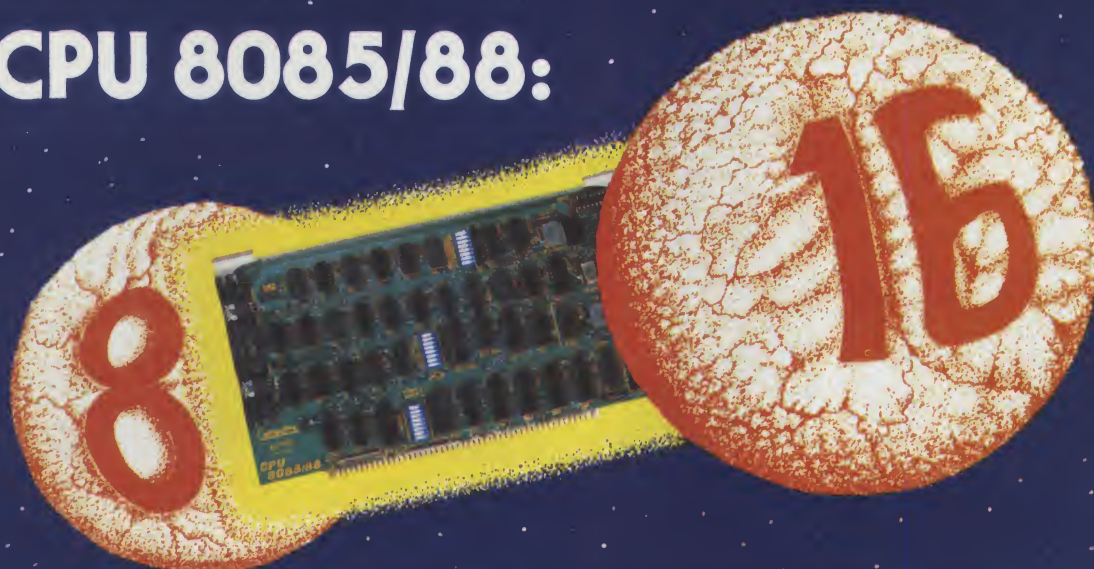
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*G. Michael Vose is a technical editor for Microcomputing magazine.*

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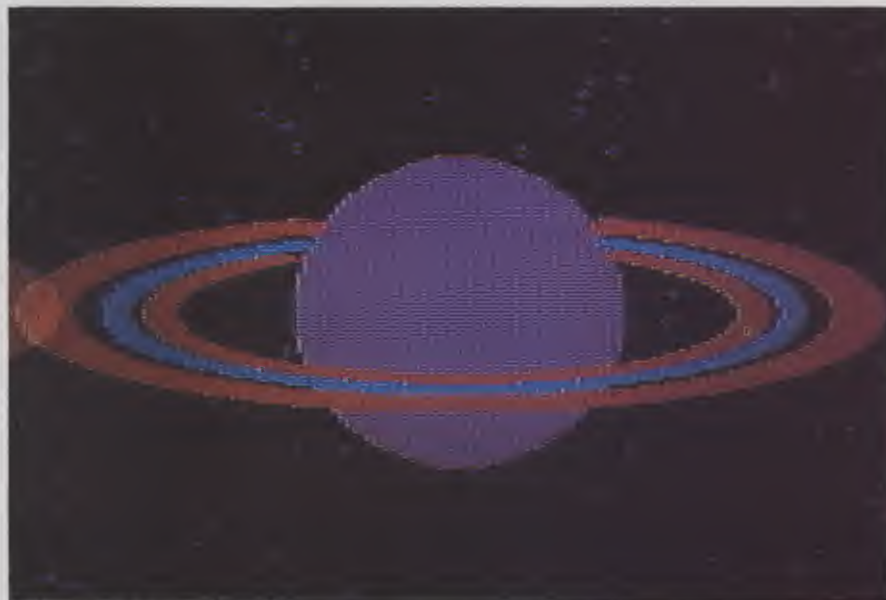
computer flexibility. The keyboard, for example, can be moved up to six feet away from the rest of the system. It can be held in your lap for comfort and ease of use. The components have a modern look but avoid the NASA laboratory look of some new computers. Like a stereo system, the Personal Computer would not be out of place in your living room.

### The Soul of the Personal Computer

Technically, the IBM Personal Computer is a second-generation microcomputer. It uses the Intel 8088 16-bit microprocessor, which can address up to 256K bytes of user memory. The processor is driven by a 4.77 MHz clock and has a 410 nanosecond cycle time.

Because IBM elected to upgrade to a 16-bit processor for its new machine, the Personal Computer can open up new possibilities to the small computer user. 256K bytes of memory will allow four times as much data handling as the eight-bit machines that have been the microcomputer standard up to now.

It can, however, be configured with as little as 16K bytes of user memory. In this configuration it carries a modest \$1595 price tag, bringing it well within reach of most homeowners and neophyte computerists. Since the system can be upgraded at any time, the minimum system will suffice to introduce many people to computers while allowing others to build a more powerful system for a specific application. Memo-



*The IBM's graphics demos are very impressive. (The overlapping at the left side of the photo resulted from a camera not a computer problem.)*

ry boards in 16K, 32K and 64K configurations are available to add to the system's power. These boards can be added by the owner. Simply plug them into slots inside the system unit. It is not necessary to have this upgrade performed by a dealer at additional cost.

The expansion slots in the system unit accept a variety of peripheral interfaces as well as additional memory. These include video-display adapters, allowing the use of an IBM monitor or a regular television set as a monitor; a printer adapter; communications adapter; and game adapter,

the latter allowing the use of game paddles or joysticks. All these adapters add to the cost of the computer.

The Personal Computer has a built-in speaker for music programming or prompting. When the system is turned on, a diagnostics program in the computer's pre-programmed memory checks the components of the system to ensure that all the parts are functioning. The cassette tape player jack accepts all standard model cassette tape recorders. The 83-key keyboard contains ten special function keys and ten keys for numeric entry and cursor control—this numeric keypad must be activated before use. The enter or return key on the Personal Computer is marked only by a stylistic arrow that curves from the vertical to the left, a rather strange departure from traditional return key marking.

The data storage options include cassette tape and 5¼-inch floppy disks. The disk drive systems may be configured with one, two or four separate drives. The drives are double-density controlled, allowing 160K bytes of data per disk. The disk drives, like the expansion memory boards, can be installed by the user. The disks are formatted with 40 tracks, eight sectors per track and 512 bytes per sector. The disk drives, reportedly built by Tandon, have a power delay circuit built in that allows the system to be turned on and off with a disk in the drive. No damage can result to the disk because the



*One of the Personal Computer's diagnostics tests the keyboard. As each key is pressed, its character appears on the screen if it is working properly.*



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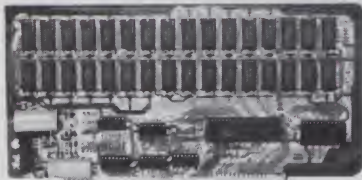
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motors and read/write heads are not activated. (A problem might develop, however, if power fails in the middle of a read/write operation.)

The monitor made by IBM for use with the Personal Computer is a monochrome display that provides 25 lines of 80 characters on an 11½ inch green phosphor screen. The computer offers upper- and lower-case letter display and the monitor supports underlining, blinking characters and inverse video. Brightness and contrast controls allow adjusting the display for reading comfort. For color display, IBM offers a graphics/color monitor adapter that interfaces the computer to a color monitor, or an rf modulator that will permit the use of a standard color television set.

Many independent computer dealers were chagrined to discover three months ago that the new Epson MX-80 printers out of Japan had become hard to obtain. Now the reason for that scarcity has become evident. The dot matrix printer being sold by IBM with the Personal Computer is an Epson MX-80 with the IBM name on it. The fact that IBM chose this high-quality, low-cost printer to accompany its system is high praise for Epson, Ltd. The printer is bidirectional and prints 80 characters per second while offering expanded or compressed print. The printer also has overstrike capability to produce near letter-quality print.

## Software from Everywhere

The IBM Personal Computer uses BASIC as its primary language. The

BASIC interpreter, contained in a 40K preprogrammed memory, was written by Microsoft, Inc., of Bellevue, WA. Called BASIC80, Version 5.0, this BASIC, when combined with the disk BASIC enhancements known as advanced BASIC, is the most complete ever produced for microcomputers. The language includes a Graphics Macro Language and a Music Macro Language for the creation of sophisticated graphics and music routines. BASIC80 also supports the use of two printers simultaneously. Up to 16 foreground and eight background colors are supported by BASIC80. Significantly, the interpreter also allows the simultaneous display of color, graphics and character information.

If the BASIC interpreter used in the IBM Personal Computer has a fault, it is the syntactical requirement that spaces be placed between commands and numbers. It is required, for example, to have a space between GOSUB and 5000 or between the 1 and TO and TO and 1000 in the statement, FOR X=1 TO 1000. This is a mainframe BASIC holdover that IBM probably incorporated to appease its long-standing mainframe users, who the company hopes will become Personal Computer owners. Unfortunately, the spaces use memory and the syntax modification will take some adjustment on the part of people used to standard microcomputer BASICs that do not require the spaces. This will make life slightly more difficult for people who plan to adapt existing BASIC programs for

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the Personal Computer.

The BASIC interpreter is about as fast as similar interpreters in the Apple and Radio Shack computers, printing the numbers 1 to 1500 in roughly 49 seconds. The system reset for the Personal Computer is a combination of the CTRL, ALT and DEL keys, pressed simultaneously—there is no simple reset switch like on many other computers.

To break the execution of a BASIC program, you must press the CTRL and break keys simultaneously. This extra keystroke should have been eliminated. The machine does have a PRT SC key which allows a dump of the screen buffer contents to the printer with a simple keystroke operation, an attractive feature that most computers lack.

### Applications

In addition to BASIC in the preprogrammed memory, the IBM Personal Computer can run a variety of software packages under its CP/M-like operating system. IBM has a licensing arrangement with Digital Research, the originators of CP/M, to use a slightly modified version of the operating system under the name, IBM DOS. With this operating system, the company has also arranged licensing agreements with Personal Software, Peachtree Software, Microsoft, Inc., and Information Software Unlimited to sell VisiCalc, Accounting and General Ledger, Adventure game and the EasyWriter word processing software packages. Communication software is also available so

that the computer can be used with a modem to communicate other computers and information services.

This software availability will certainly make the machine an attractive buy. But prospective buyers should be aware that none of these packages can run on a system with only 16K of user memory—Adventure needs 32K and the rest require 64K bytes of memory.

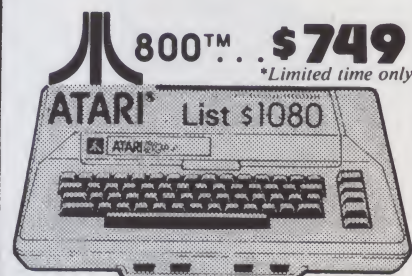
### Price and Availability

The Personal Computer will not be inexpensive but, as a second-generation machine, it probably shouldn't be. With an IBM monochrome display, 64K of memory, printer and two disk drives, a system will cost about \$4500. A 48K system with one disk drive and no printer will run \$2295. Additional memory will cost \$95 to \$593. Software packages will run from \$270 for VisiCalc to \$995 for the Peachtree Accounting packages (all prices quoted are from Computerland).

IBM has promised that the machines will be available after Oct. 15. The Personal Computer will be sold through IBM Business Centers, Computerland stores and the new Sears Business Systems Centers. Speculation is that the company may announce eight-inch disk drives for the Personal Computer as early as February and eventually hard-disk drives.

Whatever happens, this new machine from an old company will have a substantial, but unpredictable, effect on an already volatile industry. ■

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# Another Industry Giant Takes a Micro Step

By Harold Nelson  
Microcomputing Technical Editor

Last June Xerox released the Xerox 820 Information Processor, which is described as "a low-cost desktop work station that can be used as a word processing station, a business computer, or both." Since its release the WORM (wonderful office revolutionary machine, Xerox's in-house code name for the 820) has undergone a name change to SAM (simply amazing machine).

Regardless of what it is called, the 820 deserves a serious look, if for no other reason (and there are other reasons) than the Xerox name it bears.

## First Impressions

The first pleasant surprise is how easy the 820 is to set up and run. Connecting the components' cables to the ports on the display console is simpler than opening and unpacking the individual components. The instructions on setup are clear and almost unnecessary.

If the optional printer is to be a part of the system, its setup (removing protective shipping restraints and installing the printwheel) is only slightly more complicated. Again the instructions are clear and easy to follow.

Booting the system is a matter of turning on the console, inserting an operating system disk in drive A, typing the letter A and pressing return.

(If you want to use the 820 with a printer as an automatic typewriter, just type T. What you type is printed immediately. Unfortunately, it's not displayed on the console screen,

which makes it nearly impossible to visually check what you have typed.)

## Word Processing

The software package you've bought determines what will happen when you boot the system. In all likelihood, this will be the word-processing package, a CP/M-based version of MicroPro's acclaimed WordStar. The package contains two documents, the *Word Processing Handbook* and the *Word Processing Applications and Reference Guide*.

The *Handbook* gives you a clear and almost painstakingly detailed account of getting started. And it con-

tains 15 tab-indexed pages of action and command summaries. But it does not tell you until page 43 that it is a good idea to make backup copies of your software disks. This is a simple process and is described on one of the tabbed pages at the back of the *Handbook*. Perhaps the *Handbook* is intended for the casual user who will not be involved with the system beyond using it as a word processor.

The first information in the *Applications and Reference Guide* is on making backup copies of software. In fact, the *Guide* is more complete in all respects. (One of the very first things you may want to do is run the diag-



The new 820 Information Processor—it is a Xerox. (Photo courtesy of Xerox Corp.)



nostic tests described in section 15.)

Once you've booted the system, made backup disks and performed diagnostic tests, you're ready to start processing some words. If this is your first time, the *Handbook* should prove very helpful. If you have some experience, you may need only the menus, and a help key that gives extensive instructions. Menus (see Table 1 for the main menu) are displayed at the top of the screen. But, if you want, you can eliminate these and use the full screen for text display.

Word processing features include:

- Search—For searching forward or backward through a document
- Find/Replace—To search for and replace a word any- or everywhere in an entire file, ignoring upper/lower case difference.
- Auto bold—For titles and so on
- Headers/trailers—For standard, multiline and alternating page headers and trailers
- Wordwrap—To automatically move a word that does not fit within the margins of a line down to a new line
- Copy/move—To move a block of text within a document or to a new document
- Auto centering—To center a line between the left and right margins
- Justification—To justify print to user-specified margins
- Underscoring
- Overstriking
- Super/subscripts—To print a half line above or below the current typing line

In the month or so that I've been using this package, I've been impressed by its power, versatility and ease of use.

### CP/M and Other Software

If you intend to use the 820 for something else, you may want the CP/M package, which consists of the CP/M disk and two documents. CP/M opens many possibilities, since CP/M has virtually become a standard microcomputer operating system. The casual user need know nothing about CP/M to use it to load and run any of the many commercially available CP/M-based programs.

In addition to running programs under CP/M, the more knowledgeable user can modify or create new programs using CP/M features. These features are described in two documents, *CP/M Primer* and the *CP/M Manual*. Neither was prepared by

# Brand-Name Shopping

By James H. Nestor

You don't realize how pervasive television is until you start to quote from TV commercials. I'm thinking of the one that features a series of salesmen trying to sell small office copy machines which are "just as good as a Xerox." The last salesman's final words are "...it is a Xerox!"

We have become a society of brand-name snobs. We buy an Oldsmobile instead of a Ford, and insist on Gloria Vanderbilt jeans. It is possible that many potential microcomputer users are waiting for an acceptable brand name to appear. As a consultant, I have met resistance from businessmen to buying a computer from Radio Shack or a company with a name such as Apple. What they seem to want is a name you can trust, something with a Fortune-500 ring to it.

### Another Microcomputer—So What?

The Xerox 820 is certainly not the only new microcomputer on the market. I collected a huge stack of literature on new products at the National Computer Convention in Chicago. With a few exceptions, most of the new micros seem about the same. Aside from an occasional daydream about hard disks and remote terminals, I am content with my two-drive Radio Shack Model II and Daisy II printer.

Still, I scan the new products announcements in several newsletters each week, looking for something truly new and exciting in the industry. The announcement of the Xerox 820 caught my attention. The elements which aroused my interest were the name Xerox, and the price—\$2995.

### Then I Met SAM

When I arrived at the local Com-

puterland, I saw a colorful sign in the window inviting me to come in and "meet SAM." I learned that SAM stands for "simply amazing machine," the nickname which Xerox has given to the 820. I also noticed that all of the literature refers to the unit as the 820 Information Processor. The term Information Processor suggests that the 820 is not just a word processor, but a processor of words and data. In fact, SAM is a microcomputer, although that term is not used.

The 820 uses a Z-80A microprocessor, and includes 64K of RAM and 4K of ROM. It has dual 5¼-inch single-density drives, and a 24 line by 80 character white-on-black display screen. The machine includes two parallel I/O ports for keyboard and disk drives, and two serial ports for printer and modem.

The hardware is housed in three white cabinets. The display and keyboard cases are molded plastic with a pebble texture. The edges are nicely contoured. The disk drives are enclosed in a white metal cabinet. The power switch, reset button and display brightness control are all located beneath the lower edge of the monitor case, and thus are safe from accidental contact. The overall appearance is uncluttered and business-like.

The rear apron is equally clean. There are only four connectors and an ac line cord. The connectors are for keyboard, disk drives, printer and modem. The connecting cables are similar in appearance and size to RG-8 coax cable, and terminated with RS-232 connectors. The ac power for the disk drives is supplied by the cable from the monitor, eliminating the need for another line cord.

The keyboard can be moved about a foot from the monitor, a feature important in reducing fatigue. The keyboard, which re-

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MAIN MENU		HELP = for assistance	
1 = go to menu	7 = delete this line	E = change help level	
2 = block menu	8 = insert line here	F = scroll up screenful	
3 = document menu	9 = insert mode(on/off)	G = scroll down screenful	
4 = format(display)	0 = repeat next command	J = find	
5 = format(nondisplay)	= scroll up line	K = find & replace	
6 = reformat papagraph	= scroll down line	L = repeat find & replace	

-----  
 You may type now -or- give a command using CTRL + (any key shown above).  
 -----

Table 1.

Xerox—the *Primer* is a Howard W. Sams book by Stephen Murtha and Mitchell Waite, and the *Manual* is almost entirely by Digital Research (producers of CP/M), with a few insertions by Xerox about the 820. Both describe such CP/M features included in the Xerox 820 version as the editor, the assembler (actually, this is the Digital Research 8080 assembler) and the dynamic debugging tool, but the *Manual* does so in more detail and includes alteration and interface guides. In addition, the *Manual* contains a few system notes on the 820 which will be helpful to the serious programmer.

Other Xerox 820 software current-

ly or soon to be available includes Microsoft BASIC, CBASIC-II, an electronic worksheet package (probably VisiCalc) and a telecommunications package. According to Xerox, "Ethernet compatibility is provided through the previously announced Xerox 872/873 communications servers. The 820 can also use the Xerox 871 interactive communications emulator for 3270-mode access to a host computer."

#### Inside the 820

The Xerox 820 is a single-board microcomputer using the Z-80 processor (at 2.5 MHz) with 64K bytes of programmable random-access memory (RAM) and 4K bytes of read-only

(from p. 95)

sembles an office typewriter keyboard, has a comfortable feel. It includes two control keys and a key labeled Help.

A separate keypad includes numerals, decimal point, +, -, DEL (delete), ESC (escape), line feed and cursor control keys.

A printer is not included but is necessary for any serious use. All of the literature refers to the Diablo 630 printer, which came with the system I tested.

The Diablo 630 is bidirectional, and types 40 characters per second. It uses either plastic or metal daisywheels. You can use either single sheets or buy an optional tractor feed. Its retail price is \$2900.

#### The System Software Is the Secret

Many microcomputer manufacturers, including IBM, DEC, Lanier and Honeywell, have chosen to sell both hardware and software. Consequently, they have limited the amount of available software. If the machine is dedicated to one purpose, such as word processing, the manufacturer's software may be adequate. But if the machine is

to be used for other purposes, problems may arise. Software development is expensive and time-consuming. While software is being written, the customer may find himself with little more than an expensive paperweight shaped like a computer.

The 820 uses the CP/M 2.2 operating system. Since only minor changes are needed to run the same program on a range of CP/M-equipped microcomputers, the SAM user has a wide range of software open to him.

In addition to the CP/M software, the 820 package includes a diagnostic disk. A word processing program is a \$495 option. Initially, Xerox will probably offer a limited selection of software. They are encouraging independent software developers to write quality software, rather than produce all of the software themselves.

#### First Comes Word Processing

With the Diablo 630 printer, SAM makes a first-class word processing system for about \$6300. This places it significantly below the price of the new word-processing systems from IBM, Wang, Lan-

(continued on p. 98)

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ier and Honeywell. With a letter-quality printer, those systems range from \$7500 to over \$10,000.

The word processing program is a variation of WordStar by Micro Pro. This is a good choice, since WordStar is considered by many to be the most powerful CP/M-based word processing software available.

The version of WordStar for the SAM has been customized for the system. For example, the delete key deletes one character to the right, and the cursor arrows move the cursor on the screen. Holding a key down for more than a second or so causes that key to repeat. I suspect that this is a hardware feature, since it isn't included in other versions of WordStar.

Pressing the Help key at any time produces instructions on the screen. Actually, it is a menu of menus, each with additional information about the program operation. WordStar has an elaborate system of help menus already. The

addition of a specific Help key adds to a feeling of confidence when using the system. I expect that future software for the SAM will make use of this key. This is a step toward making micros more friendly.

### The Manuals

Three manuals are included. The system includes the CP/M manual. Unfortunately, the first several chapters are from Digital Research, the company which owns the rights to CP/M. These are among the most unreadable documents I have encountered. The folks at Computerland had wisely inserted one of the newer guides to CP/M inside the binder. If Xerox must include the original CP/M documents, they might consider placing them in the back of the binder as an appendix.

Three chapters are written specifically for the SAM. The first explains the system tests performed by the diagnostic disk. They in-

(continued on next page)

memory (ROM). It provides 24 lines by 80 characters of memory-mapped video display. The 820 has a real-time clock, and uses the Western Digital 1771 disk-controller chip for floppy-disk I/O. The two parallel ports are used for the keyboard and the Shugart-compatible disk drives. There are two RS-232 serial ports, one designated for the optional printer and the other for communications.

The board and the interfaces are located in the same unit as the 12-inch black and white video display. The 96-character ASCII keyboard is a separate unit and includes a 20-key function and numeric pad. The standard 5¼-inch single-density disk drives are in a third unit (optional eight-inch drives are available).

Even though I'm impressed with the overall performance of the 820, it seems that it could have been even better. For example, why does the microprocessor run at 2.5 instead of 4 MHz, and why are single instead of double-density drives used?

### Cost

The standard Xerox 820 system (console, keyboard and dual 5¼-inch drives) sells for \$2995. The system with the optional serial printer (the excellent letter-quality Diablo 630) costs \$5895. Optional eight-inch disk drives go for an additional \$800.

The 820 is being sold at Xerox stores, and at additional retail outlets such as Computerland stores.

### Conclusions

Xerox's new 820 Information Processor is not designed to be a home or hobbyist's computer. In fact, the 820 is not nearly as impressive as some other personal computers, such as Xerox's own Star, which costs three to four times as much as the 820.

Nevertheless, the 820 is a sound product that does what it was intended to do for the user it was designed for. And though it may not be a very flashy system, probably more important is the fact that it's very comfortable to use.

Xerox has given no consideration to games, color or graphics. But the 820 is a good choice for anyone who has to do a good deal of writing. A few 820 computers could be connected via a local network to share resources or a common printer.

The 820 is, as Xerox states, intended to be a word processing and business applications work station. At that it is a success. ■

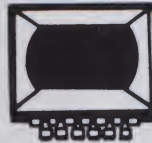
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clude two memory tests, a screen display test, a disk read/write test and a printer test for the Diablo 630. The chapter is well-written, illustrated and easy to follow. Properly used, the system tests should eliminate a few needless calls to the computer store.

The second chapter presents the Diablo 630 printer in considerable detail. While it is not a service manual, it does explain how the printer works. It certainly contains enough understandable information for the end user.

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The purchaser of the 820  
will be . . .  
a lawyer, a wholesaler,  
a CPA, a writer.

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The third chapter contains some 24 pages of information about the 820 Information Processor. It includes a description of the system architecture, discusses the ROM monitor routines and lists addresses for subroutines. There are even pin-out diagrams of the I/O ports. Xerox does not intend to keep any secrets about the SAM. The only thing I didn't see mentioned was a description of the bus architecture.

The word processing manual contains the same chapters on the 630 and the 820 system, plus troubleshooting tips. Of course, it also includes information on operation of the word processing program. I didn't have time to examine this manual in detail, but it seems to be complete and readable.

The third manual is a pocket guide to the word processing program. It includes self-instructional material and illustrations. The last 15 pages or so are tab-indexed, and contain detailed instructions and examples. If, for example, you want to use boldface type, you can easily find the section on print enhancements in the index. This manual, combined with the help features, should make it easy for a new user to get started.

#### Other Features

When the machine is first turned on, the ROM monitor displays two

options on the screen:

A—Boot System

T—Typewriter

Typing A and pressing the return key loads the system. The word processing disk automatically loads and executes. In fact, you don't need to exit to the operating system; you can read the disk directories, change disks and execute CP/M utilities such as STAT or PIP directly from the program menu.

The typewriter option is a ROM monitor function, and does not require a disk in either drive. It permits the unit to function from keyboard-to-printer, like a typewriter. Characters are not displayed on the monitor, but are printed directly on the printer.

While the inclusion of the Typewriter mode does not seem like much, it shows an awareness of the day-to-day routine in most offices. Frequently, the installation of a word processor does not eliminate the need for a regular office typewriter. It is not only overkill, but downright awkward to use WordStar to address envelopes or type shipping labels.

#### Who Is That Masked End-User?

I have repeatedly referred to the SAM end-user. Who is he or she? My impression is that the average purchaser of the 820 Information Processor will not be a computer hobbyist, who can find the hardware and software features of the SAM in several other machines. The board-level tinkerer can duplicate the system for less money. The more serious hobbyist can find a selection of more powerful hardware.

The purchaser of the 820 will be a business or professional person: a lawyer, a wholesaler, a CPA, a writer. He will be responsive to two things about the SAM: the brand name and the price.

I also predict that the average end-user will find a lot to like. The user who has previous word processing experience will find that the 820 offers many large system features at a fraction of the price. The person who has never tried computerized word processing will be amazed. Personally, I broke all of my #2 pencils and turned my typewriter into a

planter.

#### What About Data Processing?

The 820 is billed as a complete information processor. That includes data as well as words. The system should function equally well in that area, based on the large number of CP/M programs available. The major limitation to serious data processing use is the limited amount of disk storage with the 5¼-inch drives. The CP/M operating system and word processing program, for example, occupy all but 9K bytes of the space on the first disk drive. That means that there is only 90K of data storage on the second drive. For all but the smallest operations, that is not enough.

There is, however, an option to replace the dual 5¼-inch drive with dual eight-inch drives. Using single-sided, single-density for-

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The fact that the new 820  
is a Xerox product  
may be its  
most important feature.

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matting, that yields about 300K per drive, sufficient space for such software as the Peachtree accounting packages.

#### Conclusions

It would seem that Xerox does not intend the 820 Information Processor to be the ultimate microcomputer. Rather, they see it as an affordable system for the entry-level user. It can also be an inexpensive component in a very complex and powerful automated office environment. The fact that the new 820 is a Xerox product may be its most important feature.

Certainly, some of the present micro manufacturers will resent the intrusion. Those of us with a broader perspective (and less capital invested) will welcome Xerox to the industry. The more systems sold, the more potential customers for software and services. And the more the public becomes aware of the importance of the microcomputer, the greater its impact on society. ■



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# Recursion: Solving Age-Old Mysteries

By Doug MacDonald

A thousand years ago, so the story goes, members of a sect of Buddhist monks were required to solve a strange puzzle on their long road to enlightenment.

Three diamond needles were mounted on a platform of brass. On one of these needles were stacked as many as 64 golden disks of decreasing size. The monks had to figure a way to move all the disks, one at a time, from the first needle to the third. The middle needle could be used to temporarily stack disks, but at no time could a larger disk be placed on top of a smaller disk.

Had these monks owned a modern digital computer—assuming the monastic powers would allow such devices on the premises—they could have used recursion to solve this problem in a snap.

The Towers of Hanoi problem, as the disk-moving puzzle has since become known, is a textbook example of this unique mathematical and programming technique called *recursion*.

## A Definition

In classic terms, recursion means defining a problem or its solution in terms of itself. In programming, a recursive routine is one which calls itself—often over and over again.

To the novice, this seems like an



outrageous form of cheating, a sort of algorithmic lifting yourself up by your own bootstraps. The programmer trying to understand a recursive procedure is more likely to see it as ancient Chinese nested boxes—boxes within boxes within boxes. Or perhaps as the Oriental snake devouring its own tail.

However mind-boggling, recursion allows elegant solutions to certain types of programming problems that would be awkward to solve by other means, and so it deserves some study. A number of high-level languages, such as Pascal, LISP and Logo, makes special provisions for use of recursive techniques.

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But before discussing programming examples, let's examine the process of recursion itself and see how it works.

### Simplifying the Problem

The idea is to reduce the complexity of a problem by restating the problem in terms of itself, but with simpler conditions, until you reach a trivial and easily solved case of the original problem.

Take an example from mathematics. The factorial of an integer  $n$ —written  $n!$ —is defined as the number multiplied by all the integers below it down to 1. Thus, 4 factorial is 4 times 3 times 2 times 1. Factorials find wide use in statistics and other math fields.

The recursive way to look at factorials is to note that  $n$  factorial is equal to  $n \times (n-1)$  factorial. And  $(n-1)$  factorial, of course, equals  $(n-1) \times (n-2)$  factorial. This redefinition continues until you reach the trivial case of  $(0)$  factorial, which is defined as 1.

Suppose you want to write a procedure to calculate the factorial of a given input  $N$ . In Pascal, for example, you might write a program such as that in Listing 1. This program requests a number to be input for  $N$ , then calculates  $N!$  and prints the result.

The actual calculation is performed by the recursive FACTCALC function. The value of  $N$  is passed to this procedure where it is first tested to see if it is equal to zero. If it is not, the value is passed to the next line which multiplies  $N$  times  $N-1$  times  $N-2$ , etc., until zero is reached. This is accomplished by the procedure calling itself from within itself (FACTCALC:  $= N \times \text{FACTCALC}(N-1)$ ). The procedure calls itself with the value of  $N$  decremented by one each time until  $N$  is zero. When  $N$  is zero the value of FACTCALC (i.e.,  $N!$ ) is printed.

Another example of a factorial procedure written in a language designed to directly handle recursion is given in Listing 2. This listing, in the Logo programming language, actually contains two procedures. The first calculates and prints the value of  $N!$ . The second procedure (READNUMBER) requests a number to be input, calls the first procedure and passes it the value input.

The first procedure (TO FACTORIAL :N :Q) calculates the factorial of input  $N$ . Input  $Q$  (which must be entered as 1) holds the values being

calculated and at the end has the value of  $N!$ . (This procedure uses a slightly different factorial algorithm than that used by the Pascal program. The algorithm used here performs two multiplications at each level rather than one, reducing the number of times the procedure calls itself.)

The FACTORIAL procedure takes the value of  $N$  and tests to see if it is less than two. If  $N$  is two or greater, the procedure multiplies  $Q$  (one) by  $N$  by  $N-1$  and gives this new value to  $Q$ . The procedure then calls itself, but this time with input  $N-2$  instead of  $N$  and the new value of  $Q$  instead of one. It again tests the input to see if it is less than two. If it is, it prints the value of  $N!$  and stops. If the input is not less than two, the procedure continues calculating and calling itself until it is, and then it prints the result.

By now you're probably saying, "Never mind this Chinese boxes business; I could do the same thing just as well with a simple loop." Granted, many problems that can be solved with recursion are also suited to iterative techniques. However, observe that the above examples require no programming overhead of setting up and decrementing loop counters, saving partial products and so on. The intent is clear, and the expression is elegant.

Another example for mathematics might be the business of raising a number to a power. Many microcomputer languages do not provide an exponential instruction, leaving the programmer to write his own.

So, instead of seeing  $N^x$  as  $N \times N \times N \dots$ , you might observe that  $N^x = N \times N^{(x-1)}$ . Continuing to redefine, you would eventually reach the case where  $x = 1$ , and  $N^x$  is simply  $N$ . A recursive subroutine to do the job would contain a statement like:

$NPOWER = N \times NPOWER(N-1)$

Here again, a looping procedure could be worked out, but the recursive solution is clear and simple.

### Other Uses

The above examples are trivial. More complex tasks, such as traversing a tree structure or calculating certain types of polynomials, are often visible to the algorithm designer only in terms of recursion.

In a nonmathematical field, suppose you wanted to derive a clear set of grammatical rules for the English language (or any language, including computer languages).

One much-used method of expres-

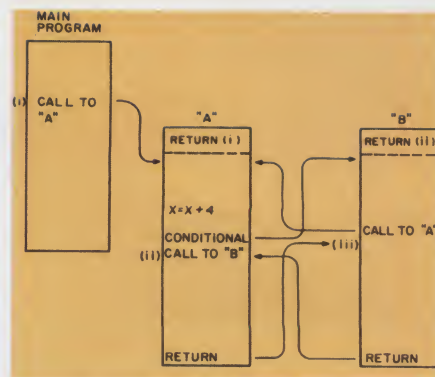


Fig. 1. Subroutine recursion.

sing language "grammars" is the Backus-Naur form (BNF). Each term or element of the grammar to be defined is followed by the symbol  $::=$ , which is read as "is composed of," plus a list of all possible subcategories of that term.

For instance, your English grammar might start:

SENTENCE  $::=$  SUBJECT PREDICATE

meaning a sentence must contain two other grammatical forms called subject and predicate. You would then proceed to further break down these terms:

SUBJECT  $::=$  NOUN | NOUN SUBJECT

Here you are saying that a subject is composed of a noun or a noun and a subject. (The vertical bar means "or.")

You'll notice that the definition of subject contains a reference to subject—exactly what is being defined! This is a recursive definition, and it is one which appears quite often in BNF.

The above example is a bit of a mind-twister at first glance, but in the end it's an efficient way of specifying that a subject may contain any number of nouns—such as "Fred and Harry and Peter and . . ." (The "and" would also have to be accounted for in the grammar, usually by a part of speech called a determiner.)

Recursion has played an important role in recent advances by linguists, as well as in the field of computer language design. As mentioned earlier, a number of high-level languages allow recursive techniques. LISP, the list processing language, is almost entirely composed of recursive statements. Others, such as FORTRAN and COBOL, do not provide for recursion.

### Recursion for the Millions

But what about the microcomputer hobbyist? What use can he or she make of recursion?



Surprisingly enough, most garden-variety BASIC interpreters allow a sort of recursion—although not intentionally. And with a little care, you can even program recursively at the machine-language level.

The major problems...  
are what to do with  
the current value of variables  
and... multiple return points.

I should mention that the above routines are examples of direct recursion. A further wrinkle can be added with indirect recursion.

Here the main program calls a subroutine—call it A—which calls a second subroutine, B. In turn, B makes a call back to A. The effect is still one of subroutine A calling itself; it just makes an extra step in doing so. Even more obscure would be subroutine A calling subroutine B, which calls subroutine C, which calls subroutine A; but this level of the snake eating its own tail is seldom seen.

The BASIC program in Listing 3 does exactly the same job as the Pascal and Logo programs and it uses the same algorithm shown in the Logo procedure. It is interesting to note that this program will run on virtually any computer with a BASIC interpreter capable of handling IF... THEN and GOSUB statements.

(Note: We tried the program in Listing 3 on a number of computers and it ran on every one, although on a few it was necessary to slightly modify lines 10 and 1000, which have nothing to do with the recursive character of the program. Commodore's VIC 20 with only 4K bytes of memory could calculate up to 23! before running out of memory. No other machine had memory problems, but they all had numeric overflow difficulties at one point or another. Most (Apple, PET and TRS-80) could handle numbers up through 33!, which isn't bad considering that 33! is about 8,683,317,618,811,886,000,000,000,000,000,000,000. The North Star Horizon went up to 49!. But if you feel some compulsion for calculating factorials on a personal computer, you will want to take a look at the Atari 800 or the TI 99/4A. The Atari could calculate 68!,

and the TI with Extended BASIC when through 69!.)

The program along with the algorithm it uses is elegantly simple. (One word of caution: Be very careful of using GOSUB statements without corresponding RETURN statements. It usually won't work.) Line 10 asked for the number whose factorial you want to determine. Line 20 just sets the value of Q at one. The variable Q will represent the value of N!, and 0! and 1! both equal one.

The program then drops into the recursive subroutine (lines 500 through 530). First the value of N is tested. If it is less than two, the program goes to line 1000, which prints the result (in this case N!=1) and ends the program. (The END in line 1000 could be changed to GOTO 10 if you absolutely have to find more than one factorial per sitting.)

If the value of N is two or larger, the program drops to line 510, which sets a new value of Q equal to the old Q (still one) times N times N-1. Line 520 sets the value of N at the original value minus two, and line 530 sends this back to line 500. If N is now less than two, the result is printed; if not, a new value for Q is determined to the value of Q from the last round times the new value of N (the original value less two) times the new N minus one. N is now set to be two less than the value of N from the last round. The program again returns to line 500 and this newest value of N is tested. This continues until the value of N is less than two (0 or 1), at which time the final result is printed.

Line 530 of the subroutine functions something like the recursive calls in the Pascal and Logo procedures. This line calls the subroutine from within itself.

## Problems

The stack is the key to recursion. Here, microcomputers have the advantage over some mainframe machines that do not have a hardware stack.

Why is the stack important? The major problems with handling recursive subroutines, which will call themselves an unknown number of times, are what to do with the current value of variables and how to keep track of multiple return points.

Consider Fig. 1, which shows a case of double recursion. The main program at some points makes a call to subroutine A. Assume for the moment that there is no stack in this par-

ticular machine; that a subroutine has within it a memory location to hold the return point, where it is supposed to return control after completion. Subroutine A then saves (i) as the location in the main calling program to which it will return control.

As it is executing, subroutine A encounters a call to subroutine B. As necessary, B stores (ii) as its return point back to A.

But now B makes a recursive call back to A. This time, subroutine A, not knowing that it has already been called once without completing its run, dutifully stores (iii) as its return point. Eventually, it returns to (iii) in B. Subroutine B continues until reaching its return instruction and passes control, as it should, to (ii). So far so good.

Then subroutine A completes its execution. But, instead of going back to (i) where it should, it passes control back to (iii) in subroutine B, which was the last return point stored. It's easy to see that there's an endless loop here, with control flickering back and forth between A and B, while you, the programmer, sit wondering just what went wrong.

Another problem arises with variables in a recursive routine. Look again at Fig. 1. Imagine that in A there is the assignment statement  $X = X + 4$ . Presumably, the main calling program wants just this action: for X to be returned four larger than it was. However, when A calls B, which in turn calls A again, the statement will be executed at least one extra time. So when A eventually passes control back to the main routine, X will actually be at least eight larger. This type of problem is extremely tough to track down.

The hardware stack is the natural way to solve the return point problem. Both machine and higher-level

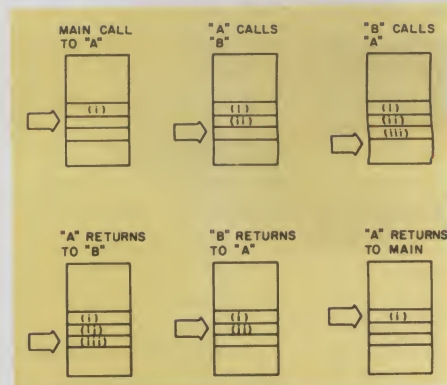


Fig. 2. Stacks shown throughout the sequence of recursive calls.



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Some people have a talent for recursion, but most of us count on fingers and toes.

language call... return sequences use the stack to push down the return point. If a subroutine encounters more than one call before completion, the extra return points are simply pushed down on top of the previous ones; during the sequence of returns, these addresses are popped off the stack in reverse order—just the order needed.

Fig. 2 shows the stack throughout the sequence of recursive calls just discussed in relation to Fig. 1. The arrow indicates the stack pointer location

(assume that the stack grows downwards). The last-in, first-out nature of the stack lets it keep perfect track of just who should pass control to whom and when.

The way to avoid unexpected loss or overwriting of variables—side effects—in recursive routines is to ensure that the routine will keep separate copies of the values for each invocation. This can be done with arrays, or use the stack to push temporary values, being careful not to destroy return points.

```
PROGRAM FACTORIAL;
VAR N : REAL;
FUNCTION FACTCALC (N : REAL) : REAL;
BEGIN
  IF N=0 THEN FACTCALC:=1
  ELSE FACTCALC:=N*FACTCALC(N-1)
END;
BEGIN (*MAIN PROGRAM*)
  WRITE ('FACTORIAL (N!) OF ');
  READLN (N);
  WRITELN ('N! = ', FACTCALC(N))
END.
```

Listing 1. A factorial program written in Pascal. The main program asks for a value of  $N$  to be input and then prints the value of  $N!$ . The value of  $N!$  is calculated by calling the recursive function *FACTCALC* and passing it the value of  $N$ . This subroutine determines  $N!$  by testing whether or not  $N$  is zero. If not, it sets the value of *FACTCALC* at  $N$  times the value of *FACTCALC*( $N-1$ ), which is the factorial of  $N-1$ . This means it is necessary to back through *FACTCALC* again and again until  $N$  equals 0, at which point *FACTCALC* equals  $N!$  and the main program prints that value.

```
TO FACTORIAL :N :Q
  IF :N<2 THEN PRINT1 'N! = PRINT :Q STOP
  MAKE 'Q :Q*N*(N-1)
  FACTORIAL :N-2 :Q
END

TO READNUMBER
  PRINT1 SENTENCE [FACTORIAL (N!) OF] []
  MAKE 'INPUT FIRST REQUEST
  IF NUMBER? :INPUT THEN FACTORIAL :INPUT 1
END
```

Listing 2. A Logo version of a factorial program. The *READNUMBER* procedure (thanks to Hal Abelson of MIT's Logo Project) works something like the main program in Pascal. It requests a value for  $N$ , then calls the *FACTORIAL* procedure and passes it the value input for  $N$  and one for  $Q$ . *FACTORIAL* tests the value of  $N$  and, if it is less than two, prints one for the value of  $N!$  and halts. If  $N$  is two or larger, the procedure changes the value of  $Q$  from one to  $Q$  (i.e., one) times  $N$  times  $N-1$ . The procedure then calls itself, but now inputs  $N-2$  instead of  $N$  and the new value of  $Q$  instead of one. This continues over and over until  $N$  is less than two and the result is printed.

```
10 INPUT "FACTORIAL (N!) OF "; N
20 Q=1
500 IF N<2 THEN GOSUB 1000
510 Q=Q*N*(N-1)
520 N=N-2
530 GOSUB 500
1000 PRINT "N! = "; Q: END
```

Listing 3. A BASIC factorial program. This program, like the others, contains a recursive routine (lines 500 through 530) which determines the factorial of an input number  $N$ .

## Conclusions

What do you look for in picking out computer tasks that are amenable to recursive solution? There are no hard and fast guidelines. Some people seem to have a native talent for seeing recursion, an intuitive understanding of its intricacies. Most of us, though, have to struggle through, scribbling state diagrams and counting on fingers and toes.

Basically, any task that requires summing or a series expansion is a prime candidate. Calculus functions with a parameter approaching zero or infinity can sometimes be handled nicely with recursion. Any subroutine that is called in a regular, repetitive way should be looked at with the idea of getting the routine to call itself until its task is done.

One typical student programming problem is to write a routine that will list all possible combinations of change from a dollar. A pleasing way to solve this problem is to use a subroutine which, for any given coin value, calculates the number of times this coin will fit in the change needed, set the remainder as the new change value and have the routine call itself with the next lower value of coin. This might be an interesting experiment to test your BASIC interpreter's recursive capabilities, but don't be disappointed if stack overflow causes your computer to freeze up.

Now that you have a basic understanding of recursion, you might like to get one up on the Buddhist monks and solve the Towers of Hanoi problem. I won't tell you how it's done, but I'll give you a hint. Don't think about the top disk on the first needle, which will be one you would move first. Think about the trivial case of moving the bottom disk from needle 1 to needle 3 and proceed from there.

May you achieve enlightenment! ■





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# Stamp Out REMs

By Paul Hitchcock

If you're a whiz at structured programming techniques and possess total recall as well, you probably don't need to use remark statements to help document your BASIC programs: everything is always logically ordered and details are never forgotten. On the other hand, I usually use a great many of them, since I often can't remember where to find my Apple's on-off switch.

But for all their usefulness in program documentation, REM statements have two not-so-useful characteristics: they consume memory and

they reduce program execution speed.

One obvious solution to these problems is to file fully-documented back-up copies of your programs, but have versions without REM statements on hand for everyday use. However, should you become hazy about the inner workings of a program and find that you've misplaced your back-up, you can spend literally hours of painful drudgery stepping through a long program in search of lost knowledge.

Another more reliable solution is to use the REM-mover program given in Listing 1. With this short machine-

language program, you can quickly eliminate REM statements from a previously loaded Applesoft program using only a single keyboard-issued command. You thus gain all of the speed and space advantages of programs without REM statements, but your on-line programs can be identical to your back-up copies; should you lose either one, you do not lose the essential documentation.

## Entering and Using REM-Mover

The REM-mover program will work only with Applesoft in ROM; it will *not* work with cassette Applesoft, diskette Applesoft or Integer BASIC. REM-mover's single limitation is that it can remove only those REM statements which begin with statement numbers; it will not remove a REM which comes at the end of another program statement.

You may enter the program as shown in Listing 1 using the Apple's mini-assembler, but it would probably be easier to use the hex dump in Listing 2. Enter the monitor with CALL-151 and type in each line as shown, remembering to change the dash after each address to a colon. When you have finished, carefully check your work. Since REM-mover

Name	Address	Function
INIT	300-308	Initialize next statement pointer to 801
EOP	309-320	Check for end of program; get next address
REMCH	321-328	Check for REM statement
NOREM	329-333	Get next statement; jump to EOP
REM	334-33A	Save address in stack
	33B-340	Calculate offset
SHIFT	341-35E	Shift BASIC program to cover REM statement
SETPT	35F-372	Set Applesoft pointers
ADJST	379-3BB	Adjust next-statement pointer bytes; get next address; jump to EOP

REM-mover uses five zero page memory locations: 06 through 09 and 19. Registers 06 and 07 hold the address of the BASIC program statement that REM-mover is currently examining; registers 08 and 09 contain the address of the next statement. Register 19 holds the "offset number," as was mentioned in the text of the article.

Table 1. REM-mover routines.

Address correspondence to Paul Hitchcock, 2309 Blake St., #308, Berkeley, CA 94704.



accesses several of Applesoft's more sensitive areas, a typing error when entering the program could cause your Apple to hang when you first attempt to use REM-mover. To resume normal operation, you would then have to turn your computer off, then on again, thereby erasing any program you had in memory.

To save the program on cassette, use the monitor command "300.3BBW (return)", making sure that your recorder is running before pressing the return key. You can save REM-mover on disk with the DOS command "BSAVE REM-MOVER, A\$300, L\$BB (return)".

Using REM-mover is simple: Load an Applesoft program that contains REM statements and remove the REMs by typing

```
(from BASIC) CALL 768 (return)
(from the monitor) 300G (return)
```

When you list your program, you'll find that all of the REM statements have vanished, leaving you with a shorter and faster-running program. Listing 3 demonstrates REM removal and also shows how REMs can adversely affect program speed.

One word of caution: If your program contains any GOTO or GOSUB statements which reference REM statements, you must change the branching addresses to ensure error-free program operation after you have removed the REMs.

## How REM-Mover Works

Understanding how REM-mover works requires an elementary knowledge of the way in which the Apple actually stores a BASIC program. Individual statements are not stored in the computer as they appear in a program listing; instead, each statement is coded into a form which is more usable from the standpoint of the BASIC interpreter.

One of the more important aspects of this coding is the assignment of a "token" to each BASIC keyword. That is, every keyword is given a number, called a token, and it is this number, rather than a string representation of the keyword, which is used by the interpreter. Using tokens for keywords such as RUN and REM not only saves memory, but also speeds up the interpreting process. The coding process is referred to, appropriately enough, as "tokenizing."

When you type in a program statement and press the return key, Applesoft tokenizes the statement and inserts it into memory immediately

following the statement with the next lowest statement number. Program storage for ROM Applesoft begins at the address 801 (hexadecimal).

To illustrate the tokenizing process, consider the following useless (but instructive) program:

```
10 REM
20 END
```

The tokenized version of this program is

```
801-07 08 0A 00 B2 00 OD
808-08 14 00 80 00 00 00
```

The bytes 801 through 806 are the machine representation of the first statement of the program, 10 REM. The first two bytes, 801 and 802, contain the starting address of the next statement: 807. (Note that the low byte precedes the high byte of the address.) The next two bytes, 803 and 804, hold the statement number 00 0A, or 10 in decimal. The fifth byte, 805, contains the number B2, which is the token for the keyword REM. Finally, the sixth and last byte of the statement, 806, contains 00, which denotes the end of the statement.

The next statement, 20 END, may be broken down into its constituent parts in exactly the same way. Notice, though, that the first two bytes of the second statement (807 and 808) seem to imply there is another statement which begins at 80D. This is clearly impossible, since the program consists of only two statements, not three. However, if you examine the first two bytes of this phantom statement, 80D and 80E, you will see that they both contain 00, instead of another set of next-statement pointers. This is how Applesoft signifies the end of a program: whenever the next-statement pointer bytes contain zeroes, the interpreter stops... well, stops interpreting.

Armed with the above information, you can now see how REM-mover works. Beginning at 801, REM-mover first tests this address and the next to see if they both contain zero; if they do, REM-mover stops. Should the zero test fail, REM-mover then checks the fifth byte of the statement for the number B2, to see if the statement is a REM statement. If B2 is *not* found, REM-mover proceeds to the next statement, whose address is found in the first two bytes of the statement currently being examined. This procedure continues until either a REM statement is found or the end of the program is reached.

If REM-mover does encounter a

REM statement, the next step it takes is to calculate an offset number, which is equal to the difference between the address of the next statement and the address of the REM itself. The offset is not used immediately, but is stored temporarily in the zero page location 19. Next, REM-mover shifts down to the address of the REM all of the remaining bytes of the program statements which follow

*300LLLLL									
00	00	00	00	00	00	00	00	00	00
01	01	01	01	01	01	01	01	01	01
02	02	02	02	02	02	02	02	02	02
03	03	03	03	03	03	03	03	03	03
04	04	04	04	04	04	04	04	04	04
05	05	05	05	05	05	05	05	05	05
06	06	06	06	06	06	06	06	06	06
07	07	07	07	07	07	07	07	07	07
08	08	08	08	08	08	08	08	08	08
09	09	09	09	09	09	09	09	09	09
0A	0A	0A	0A	0A	0A	0A	0A	0A	0A
0B	0B	0B	0B	0B	0B	0B	0B	0B	0B
0C	0C	0C	0C	0C	0C	0C	0C	0C	0C
0D	0D	0D	0D	0D	0D	0D	0D	0D	0D
0E	0E	0E	0E	0E	0E	0E	0E	0E	0E
0F	0F	0F	0F	0F	0F	0F	0F	0F	0F
10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19
1A	1A	1A	1A	1A	1A	1A	1A	1A	1A
1B	1B	1B	1B	1B	1B	1B	1B	1B	1B
1C	1C	1C	1C	1C	1C	1C	1C	1C	1C
1D	1D	1D	1D	1D	1D	1D	1D	1D	1D
1E	1E	1E	1E	1E	1E	1E	1E	1E	1E
1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
20	20	20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21	21	21
22	22	22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28	28	28
29	29	29	29	29	29	29	29	29	29
2A	2A	2A	2A	2A	2A	2A	2A	2A	2A
2B	2B	2B	2B	2B	2B	2B	2B	2B	2B
2C	2C	2C	2C	2C	2C	2C	2C	2C	2C
2D	2D	2D	2D	2D	2D	2D	2D	2D	2D
2E	2E	2E	2E	2E	2E	2E	2E	2E	2E
2F	2F	2F	2F	2F	2F	2F	2F	2F	2F
30	30	30	30	30	30	30	30	30	30
31	31	31	31	31	31	31	31	31	31
32	32	32	32	32	32	32	32	32	32
33	33	33	33	33	33	33	33	33	33
34	34	34	34	34	34	34	34	34	34
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36	36	36	36	36	36	36	36	36	36
37	37	37	37	37	37	37	37	37	37
38	38	38	38	38	38	38	38	38	38
39	39	39	39	39	39	39	39	39	39
3A	3A	3A	3A	3A	3A	3A	3A	3A	3A
3B	3B	3B	3B	3B	3B	3B	3B	3B	3B
3C	3C	3C	3C	3C	3C	3C	3C	3C	3C
3D	3D	3D	3D	3D	3D	3D	3D	3D	3D
3E	3E	3E	3E	3E	3E	3E	3E	3E	3E
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41	41	41	41	41	41	41	41	41	41
42	42	42	42	42	42	42	42	42	42
43	43	43	43	43	43	43	43	43	43
44	44	44	44	44	44	44	44	44	44
45	45	45	45	45	45	45	45	45	45
46	46	46	46	46	46	46	46	46	46
47	47	47	47	47	47	47	47	47	47
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49	49	49	49	49	49	49	49	49	49
4A	4A	4A	4A	4A	4A	4A	4A	4A	4A
4B	4B	4B	4B	4B	4B	4B	4B	4B	4B
4C	4C	4C	4C	4C	4C	4C	4C	4C	4C
4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
4E	4E	4E	4E	4E	4E	4E	4E	4E	4E
4F	4F	4F	4F	4F	4F	4F	4F	4F	4F
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58	58	58	58	58	58	58	58	58	58
59	59	59	59	59	59	59	59	59	59
5A	5A	5A	5A	5A	5A	5A	5A	5A	5A
5B	5B	5B	5B	5B	5B	5B	5B	5B	5B
5C	5C	5C	5C	5C	5C	5C	5C	5C	5C
5D	5D	5D	5D	5D	5D	5D	5D	5D	5D
5E	5E	5E	5E	5E	5E	5E	5E	5E	5E
5F	5F	5F	5F	5F	5F	5F	5F	5F	5F
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68	68	68	68	68	68	68	68	68	68
69	69	69	69	69	69	69	69	69	69
6A	6A	6A	6A	6A	6A	6A	6A	6A	6A
6B	6B	6B	6B	6B	6B	6B	6B	6B	6B
6C	6C	6C	6C	6C	6C	6C	6C	6C	6C
6D	6D	6D	6D	6D	6D	6D	6D	6D	6D
6E	6E	6E	6E	6E	6E	6E	6E	6E	6E
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79	79	79	79	79	79	79	79	79	79
7A	7A	7A	7A	7A	7A	7A	7A	7A	7A
7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
7C	7C	7C	7C	7C	7C	7C	7C	7C	7C
7D	7D	7D	7D	7D	7D	7D	7D	7D	7D
7E	7E	7E	7E	7E	7E	7E	7E	7E	7E
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87	87	87	87	87	87	87	87	87	87
88	88	88	88	88	88	88	88	88	88
89	89	89	89	89	89	89	89	89	89
8A	8A	8A	8A	8A	8A	8A	8A	8A	8A
8B	8B	8B	8B	8B	8B	8B	8B	8B	8B
8C	8C	8C	8C	8C	8C	8C	8C	8C	8C
8D	8D	8D	8D	8D	8D	8D	8D	8D	8D
8E	8E	8E	8E	8E	8E	8E	8E	8E	8E
8F	8F	8F	8F	8F	8F	8F	8F	8F	8F
90	90	90	90	90	90	90	90	90	90
91	91	91	91	91	91	91	91	91	91
92	92	92	92	92	92	92	92	92	92
93	93	93	93	93	93	93	93	93	93
94	94	94	94	94	94	94	94	94	94
95	95	95	95	95	95	95	95	95	95
96	96	96	96	96	96	96	96	96	96
97	97	97	97	97	97	97	97	97	97
98	98	98	98	98	98	98	98	98	98
99	99	99	99	99	99	99	99	99	99
9A	9A	9A	9A	9A	9A	9A	9A	9A	9A
9B	9B	9B	9B	9B	9B	9B	9B	9B	9B
9C	9C	9C	9C	9C	9C	9C	9C	9C	9C
9D	9D	9D	9D	9D	9D	9D	9D	9D	9D
9E	9E	9E	9E	9E	9E	9E	9E	9E	9E
9F	9F	9F	9F	9F	9F	9F	9F	9F	9F
A0	A0	A0	A0	A0	A0	A0	A0	A0	A0
A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
A2	A2	A2	A2	A2	A2	A2	A2	A2	A2
A3	A3	A3	A3	A3	A3	A3	A3	A3	A3
A4	A4	A4	A4	A4	A4	A4	A4	A4	A4
A5	A5	A5	A5	A5	A5	A5	A5	A5	A5
A6	A6	A6	A6	A6	A6	A6	A6	A6	A6
A7	A7	A7	A7	A7	A7	A7	A7	A7	A7
A8	A8								



the REM, thereby covering up the REM.

After the shift operation, the BASIC

program's length is decreased by an amount equal to the offset mentioned above. To compensate for this de-

crease in program length, REM-mover subtracts the offset from several important Applesoft pointers, then stores the results back into the proper locations. These pointers are

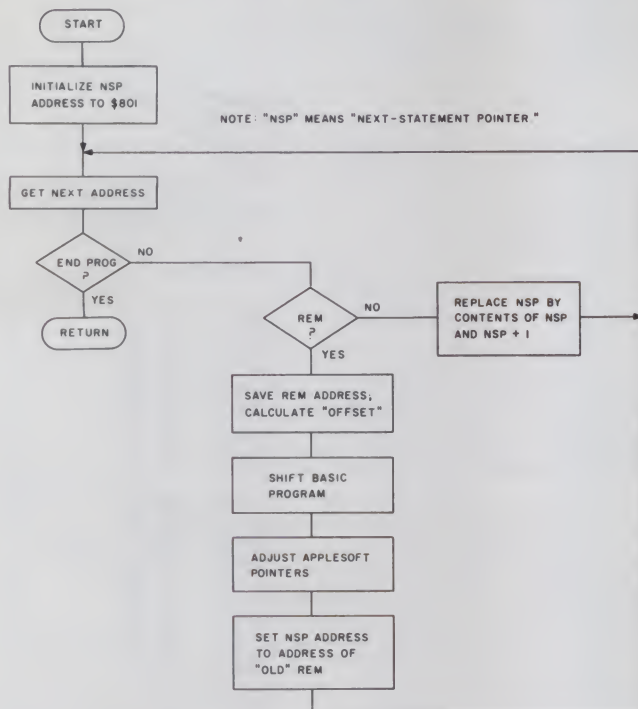


Fig. 1. REM-mover flowchart.

ICALL-151

\*300.3BC

```

0300- D8 A9 01 A0 08 85 06 84
0308- 07 A2 00 A0 00 B1 06 85
0310- 08 D0 01 E8 C8 B1 06 85
0318- 09 D0 01 E8 E0 02 D0 01
0320- 60 A0 04 B1 06 C9 B2 F0
0328- 0B A5 08 A4 09 85 06 84
0330- 07 4C 09 03 A5 07 48 A5
0338- 06 48 38 A5 08 E5 06 85
0340- 19 A0 00 B1 08 91 06 E6
0348- 06 D0 02 E6 07 E6 08 D0
0350- 02 E6 09 A5 08 C5 AF D0
0358- EA A5 B0 C5 09 D0 E4 A5
0360- 06 85 AF 85 69 85 68 85
0368- 6D A5 07 85 B0 85 6A 85
0370- 6C 85 6E 68 85 06 A8 68
0378- 85 07 48 98 48 A2 00 A0
0380- 00 B1 06 85 08 D0 01 E8
0388- C8 B1 06 85 09 D0 01 E8
0390- E0 02 D0 09 68 85 06 68
0398- 85 07 4C 09 03 A0 00 38
03A0- A5 08 E5 19 85 08 91 06
03A8- B0 07 C8 C6 09 A5 09 91
03B0- 06 A5 08 A4 09 85 06 84
03B8- 07 4C 7D 03 00
  
```

Listing 2. REM-mover hex dump.

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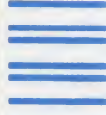
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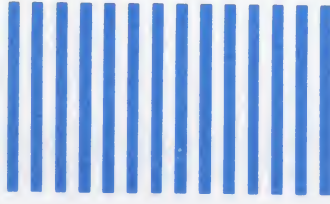
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contained in the addresses 69 through 6E and in AF and B0. Rather than go into a detailed explanation of the functions of these pointers, let me refer you to the appendix in the *AppleSoft II Reference Manual* entitled "Zero Page Memory Map."

Next, the same offset is used again to adjust the next-statement pointer bytes for all of the shifted statements. REM-mover returns to the address of the first byte of the now-removed REM statement; this address is now the address of the statement which originally followed the REM. The offset is then subtracted from these two bytes and the result is deposited back into the addresses. Using this new pointer address, REM-mover goes to the next statement, subtracts the offset and repeats this procedure until it reaches the end of the program.

Finally, the REM-mover returns to the address of the removed REM statement and starts anew the search for the next REM. When all of the REM statements have been removed, the machine-language program returns control of the computer back to you. REM-mover is quite fast; it will delete 1000 bytes of REM statements

in less than 18 seconds.

Because the algorithm for removing REMs can be confusing, I have included Fig. 1 and Table 1. Fig. 1 is a

simplified flowchart of the REM-mover program and Table 1 lists the addresses and functions of REM-mover's important routines. ■

#### JLIST

```
10 REM ....REM STATEMENTS
20 REM ....CONSUME SPACE.
30 REM
40 FOR I = 1 TO 1000
50 REM
60 REM ....AND IN LOOPS,
70 REM ....REM STATEMENTS
80 REM ....CONSUME TIME!
90 REM
100 NEXT
```

JCALL 768

#### JLIST

```
40 FOR I = 1 TO 1000
100 NEXT
```

#### JLIST

```
10 REM ....REM STATEMENTS
20 REM ....CONSUME SPACE.
30 REM
40 FOR I = 1 TO 1000
50 REM
60 REM ....AND IN LOOPS,
70 REM ....REM STATEMENTS
80 REM ....WASTE TIME!
90 REM
100 NEXT
```

JCALL 768

#### JLIST

```
40 FOR I = 1 TO 1000
100 NEXT
```

*Listing 3. REM statements can drastically increase program execution time. The program containing REM statements took 3.5 seconds to complete a RUN, while the version without REM statements required only 1.2 seconds.*

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61DB7



# 68xx Secrets

By Peter A. Stark

**W**hen asked to review Dynamite—a 6809 disassembler program—I jumped at the chance. The first step, of course, was to get my system to the point where switching back and forth between the 6800 and 6809 processor boards would be easy. Little did I know what that would lead to!

The review of Dynamite turned out to be the last thing done, but I'll cover that first.

Dynamite is a superb disassembler program being marketed by the Computer Systems Center (13461 Olive Blvd., Chesterfield, MO 63017). Although it runs on a 6809 and requires the FLEX 9 disk operating system and a minimum of 24K bytes of programmable random-access memory (RAM), it can disassemble both 6800 and 6809 code.

Using the word superb to describe it is not an exaggeration. In quite a bit of use, it has proven to be invaluable and, despite much effort, I can think of little I'd change on it if I had my way.

Essentially, a disassembler is a program which takes a machine-language program and translates it into assembly language. Several other 68xx disassemblers are available, dating all the way back to the SWTP Desembler, and a Motorola disassembler before that. Dynamite is thus not the first, but it definitely has some features that put it in a class of its own.

Unlike earlier disassemblers that work on a machine-language program in memory, Dynamite takes machine code from a disk file. This

has several advantages. It's not necessary to load the program first, and worry about whether it will conflict with the disassembler itself. A more visible advantage is that you don't have to even know the starting and ending addresses of the program being disassembled. Even if it is split up into several segments which lie in different places, Dynamite will insert the appropriate ORG statements into the assembly code, and will not disassemble locations that are not part of the program.

(It is possible to disassemble just part of a disk file. This is useful if you need to work on a certain segment of a program—I/O, for example, or when the program is too large for the assembly listing to fit on one disk.)

Dynamite can produce a printed disassembled listing (which includes both the machine code as well as the assembly-language code in the same format as would be produced by an assembler), or it can write just the assembly-language code to another disk file. This code is in the right format so it can immediately be reassembled. I tried it out on several long system programs, to see whether, if I disassembled with Dynamite and then reassembled its output, I would get the same machine-language program. In each case, that's exactly what I got. It's obviously not very useful, but it is a good test to make sure Dynamite works.

The foregoing are simply the basics that any good disassembler should do. But Dynamite has some additional features.

First, a typical machine-language

program does not contain only instructions. Buried among the instructions may be ASCII text, data or address pointers. Since no disassembler can be intelligent enough to find these by itself, there must be some way of manually identifying and specifying them.

If you have a printed program listing of what you're disassembling, then it's a simple (though perhaps lengthy) matter to go through it and identify each portion. Lacking that, Dynamite can help. By invoking an optional ASCII printout (in which Dynamite converts all printable codes into their ASCII characters and prints them), it is easy to find text strings in the code. Since Dynamite converts all unrecognizable instructions into FCB statements automatically, this is a good beginning. By letting Dynamite go through the machine-language program several times, displaying the result on the terminal, you can visually identify most data and text areas and separate them from pure code.

Once program and data areas are identified, you must tell Dynamite what they are. This information can be entered directly from the keyboard, or can be stored in a command file. Direct keyboard entry is more convenient and faster, but really only useful for short programs. When disassembling long programs, it is far more convenient to store this information as a separate command file, which is read by Dynamite during

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disassembly. This latter approach is especially convenient when making multiple passes through a strange program. As each pass uncovers more data and text areas, you simply add them to the command file without re-typing information already there.

Dynamite command files are text files that look like this:

```
A 2010-2022
B 2044-2046
L 2100-2101
W 2200-2213
```

The letters identify the type of data—A for ASCII, B for byte, L for label and W for two-byte (word) data—and are followed by the address range. For example, the above example specifies that locations 2010 through 2022 contain ASCII text.

A typical calling sequence to start Dynamite looks like

```
+++DYNAMITE INFILE OUTFILE
```

```
+OPTIONS +COMMAND-FILE
```

which contains the disk file names of the machine-language code input file, as well as the assembly-language output file, if any, a list of options, and the name of the command text file.

Possible options include printing of ASCII codes, prompting for commands from the keyboard, writing to the disk or a printer, generating line numbers or paginating, disassembling just a segment of a program, disassembling 6800 or 6809 code and using alternate disk drives.

An even more interesting aspect of Dynamite is how it handles the generation of labels. Whenever disassembling a machine-language program into assembly language, you must insert labels into the resulting assembly code. Dynamite does this by generating dummy labels which consist of the letter L followed by the address of that label in the original program; for example, LE1D1 would be the label assigned to location E1D1 hexadecimal. This makes it easy to find these labels in an assembly listing.

But many locations already have standardized labels. For example, most 6800 users will recognize E1D1 as being the address of OUTEEE in the monitor. Dynamite is smart enough to know that too!

In addition to reading a command file from disk, Dynamite can also read label files. A label file is a file that tells Dynamite what labels to assign to specific locations.

Dynamite is supplied with five label files: DISLBL00, DISLBL09, SBUGLBL, SWTBGLBL and

B 0050-01FF	A 027D-027E	L 02EA-02EB	B 034A-034A
A 0214-021A	L 027F-0280	A 02EC-02F3	A 034B-0354
L 021B-021C	A 0281-0287	L 02F4-02F5	A 044C-044D
A 021D-021E	L 0288-0289	A 02F6-02F7	A 0458-045E
L 021F-0220	A 028A-028B	L 02F8-02F9	A 0464-0470
A 0221-0227	L 028C-028D	A 02FA-02FE	A 0476-0482
L 0228-0229	A 028E-0291	L 02FF-0300	A 0946-0948
A 022A-022B	L 0292-0293	A 0301-0304	L 0949-094A
L 022C-022D	A 0294-0298	L 0305-0306	A 094B-094E
A 022E-0234	L 0299-029A	A 0307-030B	L 094F-0950
L 0235-0236	A 029B-029D	L 030C-030D	B 0951-0952
A 0237-023B	L 029E-029F	A 030E-030F	L 0953-0954
L 023C-023D	A 02A0-02A4	L 0310-0311	B 0955-0955
A 023E-0240	L 02A5-02A6	A 0312-0315	A 0982-0988
L 0241-0242	A 02A7-02AE	L 0316-0317	A 0A31-0A47
A 0243-0244	L 02AF-02B0	A 0318-031B	A 0BF2-0C07
L 0245-0246	A 02B1-02B3	L 031C-031D	A 0C77-0C86
A 0247-024D	L 02B4-02B5	A 031E-031F	A 0D7F-0DCA
L 024E-024F	A 02B6-02B7	L 0320-0321	A 0FCA-0FD3
A 0250-0251	L 02B8-02B9	A 0322-0328	A 10B4-10CF
L 0252-0253	A 02BA-02C1	L 0329-032A	A 1241-1244
A 0254-025A	L 02C2-02C3	A 032B-032C	L 1245-1246
L 025B-025C	A 02C4-02C5	L 032D-032E	A 1247-124B
A 025D-0260	L 02C6-02C7	A 032F-0334	L 124C-124D
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A 026E-0271	L 02D9-02DA	A 033F-0343	A 1511-1525
L 0272-0273	A 02DB-02E3	L 0344-0345	A 17EF-1859
A 0274-027A	L 02E4-02E5	A 0346-0347	B 185A-19DA
L 027B-027C	A 02E6-02E9	L 0348-0349	

Listing 1. Dynamite command file for disassembling the MiniFlex editor.

MFLEXLBL. These contain, respectively, the labels for 6800 FLEX, 6809 FLEX, SBUG, SWTBUG and 6800 MiniFLEX. (FLEX, UNIFLEX and MiniFLEX are registered trademarks of Technical Systems Consultants, and SBUG and SWTBUG are registered trademarks of Southwest Technical Products Corp.) These label files are remarkably complete, and even include some data not commonly known.

Using these label files, Dynamite produces a very readable assembly listing. But there is more—it is easy to write your own label file, which can then either be appended to one of the predefined label files, or can be used in addition to it. Thus it is possible to produce an assembly-language file which is full of meaningful labels, and do it fairly simply. With other disassemblers, this can only be achieved by fairly lengthy editing of the resulting assembly code.

My only complaint about Dynamite has to do with its label files. To make it easy for Dynamite to read the file, label files are written as assembly-language files and then assembled. For example, a typical label file

might begin as

```
FCC 'INEEE'
FDB $E1AC
FCC 'OUTEEE'
FDB $E1D1
```

and would then have to be assembled into a .BIN file before Dynamite can use it. It would be nice if Dynamite could use the text file as is without the extra assembly. But that is just a minor inconvenience. Other than that, Dynamite is superb.

### Dynamite Example

Because Dynamite can disassemble 6800 as well as 6809 code, it seemed useful to try it out on a real practical job—converting the MiniFLEX version of TSC's text editor to run under FLEX 9 on a 6809. The decision to convert a MiniFLEX editor to FLEX 9, rather than starting with a FLEX 2 editor, was made since it seemed to be more of a test of Dynamite. It worked out well, but in the process I discovered that it really wasn't so easy and practical after all. Though Dynamite did a great job disassembling the editor, an editor was needed to edit the resulting assembly code before it could be reassembled



for the 6809. And if you already have a 6809 editor, then there isn't much need to convert one from the 6800.

Nevertheless, the procedure for doing a typical conversion goes like this:

Since Dynamite runs on a 6809, the first step is to get the program to be converted onto a disk that Dynamite can read on the 6809. There are several ways to do this. One is to load it into memory on a 6800 system, dump it out to cassette, read that cassette into a 6809 system and save it on tape. If the 6800 and 6809 systems are near each other, their RS-232C ports can be connected, and the cassette commands used to transfer from one to the other. A third way is to transfer the program from a MiniFLEX disk to a FLEX 2 disk on the 6800, resulting in a disk that can be read on the 6809. Finally, it is possible to write a utility for reading MiniFLEX disks on a 6809.

Once the program is on a 6809 disk, it is time to do a few disassemblies and identify data areas. Listing 1 is the resulting command table I came up with for the MiniFLEX editor. Normally, an editor would be used to prepare this file, though it is possible

to use the BUILD utility if you type well enough.

The next step is to use Dynamite to disassemble the code, resulting in an assembly-language file on a 6809 FLEX 9 disk. This file must now be edited so it can be reassembled into the correct code.

When converting the editor itself, this turns out to be a problem that has both obvious and not-so-obvious solutions. (A year ago, when I predicted that converting to a 6809 would cost a lot of money for software, one irate reader complained about my negative attitude, and insisted that he had no problem converting all of his disk software from a 6800 to a 6809. Wonder how he solved this one!)

The editing involved several items. First, all DOS references had to be changed to their new addresses. (See Listing 2 for a cross-reference list of

commonly-used locations in various DOS implementations.)

For the benefit of anyone trying to repeat this particular conversion, several references to the 6800 monitor also had to be changed. This involved changing an A048 hexadecimal to CC16, E1D1 to CD0F, and E1AC to CD09. Another change involved changing a BEQ instruction to LBEQ (in line 2682 if you use the same command file). Since the 6809 code is slightly longer, the branch in the 6809 code was too long for the standard BEQ instruction. Another change involved changing a line which read CPX #LINBUF to read CPX #C000, so as to avoid potential problems with the machine stack.

The last change required lengthening the read and write FCB buffers from the 192 bytes used in MiniFLEX to the 320 bytes used in FLEX 9. In my case, the obvious places were to

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TTYEOL	7082	AC02	CC02	POUT	ACE4	CCE4
TTYDP	7083	AC03	CC03	COLDS	7100	AD00
TTYWD	7084	AC04	CC04	WARMS	7103	AD03
TTYNL	7085	AC05	CC05	RENTER	7106	AD06
TTYTB	7086	AC06	CC06	INCH	7109	AD09
TTYBE		AC07	CC07	INCH2		AD0C
TTYEJ	7088	AC08	CC08	OUTCH	710C	AD0F
TTYPS	7089	AC09	CC09	OUTCH2	7136	AD12
TTYESC	708A	AC0A	CC0A	GETCHR	710F	AD15
SYSDRV	708B	AC0B	CC0B	PUTCHR	7112	AD18
WRKDRV	708C	AC0C	CC0C	INBUFF	7115	AD1B
SYSMTH		AC0E	CC0E	PSTRNG	7118	AD1E
SYSDAY		AC0F	CC0F	CLASS	711B	AD21
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UCMDTB	7092	AC12	CC12	RSTRIO	7124	AD2A
LINPTR	7094	AC14	CC14	GETFIL	7127	AD2D
ESCRET	7096	AC16	CC16	LOAD	712A	AD30
CURCHR		AC18	CC18	SETEXT	712D	AD33
PRVCHR	709A	AC19	CC19	ADDBX	7130	AD36
CURLIN	709B	AC1A	CC1A	OUTDEC	7133	AD39
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XFERAD	709F	AC1E	CC1E	GETHEX	713F	AD42
ERRTYP	70A2	AC20	CC20	OUTADR		AD45
SPECIO		AC21	CC21	INDEC		AD48
OUTSW	70A3	AC22	CC22	DOCMND	7142	AD4B
INSW		AC23	CC23	STAT		AD4E
OUTFIL		AC24	CC24	SYSFCB	7740	A840
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CURCLM	70A6	AC29	CC29	FMS	7806	B406
MEMEND		AC2B	CC2B	BASFCB	7809	B409
ERRVEC		AC2D	CC2D	CURFCB	780B	B40B
FILEKO		AC2F	CC2F	VRFYFG	782D	B435
CPUTYP		AC33	CC33	TTYDPX	7087	
PRTADR		AC35	CC35	ACIAFG	70A1	
PRTLNG		AC37	CC37			

Listing 2. DOS addresses for MiniFlex, Flex 2.0 and Flex 9.



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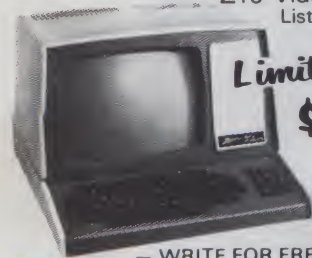


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add an RMB 128 just before labels L191A and again just before the \$0D that is just above L19DB. A not so obvious change (which took a while to find) was to change a STA 192,X instruction to STA 320,X in the middle of the program.

And then it worked!

Disassembling an editor and then converting it to run on the 6809 is not really practical, but is at least feasible. But other jobs are not so feasible. For example, it would be very difficult to convert the 6800 assembler to run on the 6809 and produce 6809 code. Likewise, converting 6800 FLEX into 6809 FLEX, or converting TSC 6800 BASIC to the 6809 would be well-nigh impossible.

In other words, Dynamite is not the solution to the high software cost of upgrading from a 6800 to a 6809. But it is a good starting point, especially these days when so few software vendors provide the source code for their products.

### Connector Problems Lead to a Separate 6809 System

Though it is possible to plug both the 6800 and the 6809 microprocessor boards into the system at the same time and switch them in and out by adding some logic circuitry, I decided to switch back and forth between the two processors by plugging and unplugging the boards. Everything worked just fine for a while, but soon I found my system becoming very unreliable. Sometimes it would work with one board and not the other; other times it wouldn't work with either.

After many hours of troubleshooting—and some lost data and programs—I narrowed it down to a connector problem. There was quite a bit of corrosion on the motherboard connectors and the system board connectors. With the continued plugging and unplugging of boards, this corrosion was being loosened, and was finding its way between contacts. I had been warned about this problem by Harold Mauch, the president of Percom Data Company, over two years ago, but never really expected to get it. What to do?

Mauch's solution was to clean the contacts with a Pink Pearl eraser at periodic intervals. While this worked, others suggested that perhaps isopropyl alcohol on a piece of cloth was safer. I ultimately went to the alcohol, with a cloth used on the male contacts of the motherboard,

and a pipe cleaner used on the female contacts of the plug-in boards. I have also tried a freon aerosol spray; while this seems to work just as well, it is much more expensive. (I spoke with the representatives of the connector manufacturer at a recent trade show, but they weren't able to offer any suggestions.)

Some manufacturers try to avoid the problem by using gold-plated connectors rather than the tin-plate used by SWTP. While this is undoubtedly the better way, it is expensive (the additional cost of gold connectors over tin adds at least \$100 to \$200 to the cost of an entire system). Moreover, if boards will be plugged and unplugged often, then the very thin gold coating is likely to be worn off quite quickly. It is also not a good idea to mix the two kinds of connectors—having gold-plated cards plugged into tin-plated connectors on the motherboard, for instance.

SWTP has recently been shipping their systems with a lubricant on the connector pins. I have not been able to find out what that is, but am on the trail of another solution.

Connector corrosion is obviously a problem not just in SS-50 systems. For example, Motorola has run into that problem on their commercial two-way radios, and has just introduced a service kit consisting of a contact cleaner and lubricant for cleaning their tin-plated connectors. I have one on order, and will try it out. (Readers in the two-way radio business may want to read Motorola Service and Repair Note 908; their part numbers are 11-82346D01 for the freon cleaner and 11-80344A80 for the lubricant.)

The problem with all of these solutions, of course, is that trying the wrong chemical may make the problem much worse.

Since connector problems are greatly worsened by plugging and unplugging boards, I decided that this had to be avoided. While I could have set up a switching scheme so both boards could stay plugged in together, this conflicted with some other plans, and so I decided to simply put some of my extra boards to use by building a separate 6809 system.

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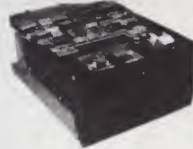
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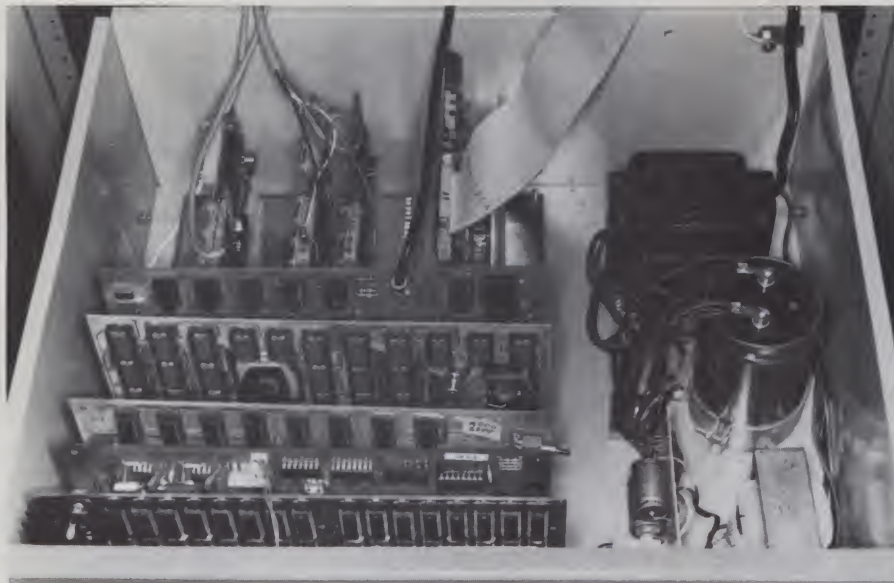


Photo 1. SWTP motherboard and a slightly modified power supply fit inside the drawer I chose with room to spare.

cided to mount my system in a rack.

Metal racks are commonly used to hold electronic equipment in industry. A typical rack is slightly over 20 inches wide, and about as deep. The height may vary from ten inches for a

desk-mount cabinet, to as high as seven or eight feet. The front of the rack is generally open, and a pair of rails along each side contains screw-holes for mounting panels, drawers or other system components. Front

panels are mostly 19 inches wide, and hence the rack is often called a 19-inch rack.

As shown in Photos 1 and 2, the system is mounted in a pull-out drawer (from Premier Metal Products Company, 381 Canal Place, Bronx, NY 10451), which measures 16 by 16 inches, and is a perfect fit for my SWTP motherboard and power supply. I used 10½-inch-high drawers (model TDR-1014) for each system, and a seven-inch-high drawer (model TDR-719) for an extra power supply.

Accessories such as disk drives are mounted on slide-out shelves (model TWS-319). The drawers and shelves are mounted on metal slides and can be slid completely out the front of the rack, so it is easy to work on any part of the system. The only problem has been with an occasional wire getting stuck in the back as a drawer or shelf is pulled out.

I keep the front of the drawer open slightly to allow heat to escape, but a fan may eventually be needed.

### Heat Dissipation of Static Memory Boards

Since I needed memory for my 6809 system, I purchased the new 32K byte static-memory board kit from Digital Research Computers of Texas (PO Box 401565, Garland, TX 75040). Although this board is available in kit form or wired, I chose the board plus support integrated circuits (ICs) plus sockets approach; at \$90.95 for a complete kit which includes everything except the memory chips themselves, this is an excellent buy.

The board uses 64 type 2114L RAM ICs; Digital Research specifies that these must be low power, and here is where I ran into some difficulties. I soon discovered that not all low-power ICs are the same.

I bought 64 ICs at \$2.98 each from Active Electronics. The total power drain for the board with 32K of RAM installed is about 2.8 amperes, and the board runs quite warm. Although it is perfectly suitable for a cabinet with an open top, such as my original SWTP box, it is too warm for my un-ventilated rack.

I subsequently discovered that even lower-power 2114 ICs are available. For example, Gimix uses Japanese 2114L RAM memories in their 32K static board, and that board takes under 2 amperes as opposed to my 2.8 amperes. This makes a big difference on a board where the memory

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chips are so close to each other as to almost touch. (With Gimix now selling their ICs at a very attractive price, this would have been a very good combination.)

The Digital Research board itself is of excellent quality, with silk-screening and extended addressing options. Given the right low power ICs, it is an excellent way of providing economical static memory for a system. In my case, though, I did not have sufficiently low power ICs for my closed, unventilated cabinet.

Rather than switch all 64 ICs, I switched to a different memory board—the 64K byte dynamic RAM board from Boaz Co. (Box 18081, San Jose, CA 95158). Though this board is somewhat more expensive (ranging from \$80 for a bare board to \$250 for an assembled board without the dynamic RAM ICs), the memory chips themselves are cheaper. This board uses the same 4116 (16K by 1 bit) chips as used in the TRS-80, Apple and many other systems. Current prices of 16K upgrades for these computers are as low as \$17, with the result that even 64K of RAM chips cost under \$70.

This board has solved my problems. Even with 64K of RAM installed (though not all is switched in due to address conflicts with the monitor and I/O) the board runs much cooler than any static memory, with the possible exception of the new static RAMs such as are available for Gimix.

#### SWTP MP-09 CPU Board Modifications

The next step was to modify my HUMBUG monitor to allow it to run on the 6809, so that I could have all the functions I had on my 6800. More problems.

My 6809 HUMBUG occupies two 2716 (erasable-programmable read-only memory) (EPROM) chips and has some very useful debugging and troubleshooting commands. Unfortunately, it didn't always work. It worked in one processor board, but not in another. Neither board worked in a different system. And some 2716s worked, others did not. Not knowing whether the problem was with my hardware or software, I obviously suspected the software. But that did not seem to lead anywhere,



Photo 2. Mounting the 6809 system in a standard 19-inch rack provides a compact and neat installation.

so I eventually transferred SWTP's SBUG monitor into a 2716, and that also didn't work.

I eventually decided that the SWTP

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MP-09A CPU board just did not like 2716 EPROMs. A conversation with the folks at Gimix (who have a remarkable knowledge of not just their own, but also their competitors', hardware) confirmed that I was right.

Most 2716s are specified as having an access time of 450 nanoseconds (ns). This means that the 2716 must receive its address and chip select inputs at least 450 ns before its data output is needed, because that's how long it takes to access a specific location.

In the MP-09A board, one memory cycle is 1000 ns long. The address is supplied to the 2716 at the beginning of the cycle, and the data is needed at the end of the cycle. Hence the address is supplied in time. But the chip select (which is a low pulse applied to pin 18 of the 2716) is not applied until about halfway through the cycle, leaving the 2716 about 400 to 500 ns to finish its job. This is just barely enough time, as most commonly available 2716 EPROMs are specified for an access time of 450 ns. Such a 2716 will occasionally output the wrong data. (Now I finally understood the comment in the SBUG

manual that when SBUG was burned into a 2716, the system could not run faster than a 1 MHz clock speed.)

There are several solutions, such as slowing down the system clock, lengthening clock pulses during ROM accesses and so on. An obvious answer is to use a faster 2716 EPROM. The 2716 is available in 450, 350 and 250 ns access times. The 350 ns part works in almost all cases, though the 250 ns part may have a somewhat greater safety factor. The disadvantage is that these faster EPROMs are more expensive, and difficult to get. I called a dozen suppliers who advertise 2716s in the popular magazines, and not one had anything faster than 450 ns.

The correct, though not necessarily simplest, solution is to fix the 2716 timing problem. This involves cutting the printed circuit board trace which leads to pin 18 of each 2716 socket, and grounding pin 18 to keep the 2716 selected at all times; this works since the same select signal also goes to the  $\overline{OE}$  pin (pin 20) of the 2716, and this pin takes over the selection job; it does not have the same delay as pin 18 does.

Unfortunately, the trace which needs cutting is under the 2716 socket. In my case, the sockets were open in the center and so a thin knife reached the trace; in some cases it may be better to bend pin 18 so it does not go into its socket, and ground it through a separate jumper.

## MP-R Programmer Notes

The MP-R programmer is normally supplied with a cassette that contains 6800 software. New EPROM programmers are supplied with SWTP Application Notice AN-109, which mentions that READPROM and WRITPROM utilities, which read and program 2716 EPROMs under FLEX 9, are available, along with FLEX 9, from SWTP for \$10.

READPROM and WRITPROM essentially transfer data from disk to EPROM or vice versa. They are not nearly as versatile as the original 6800 program, which allowed a 2716 to be verified, or which allowed partial programming. There is a need for someone to develop better programmer software, especially for those people who are using 6809 systems without FLEX 9.

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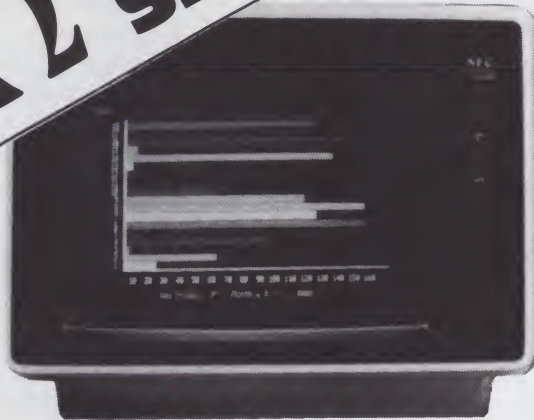
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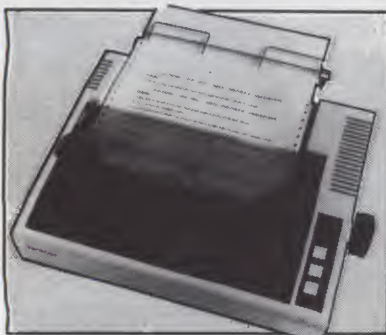
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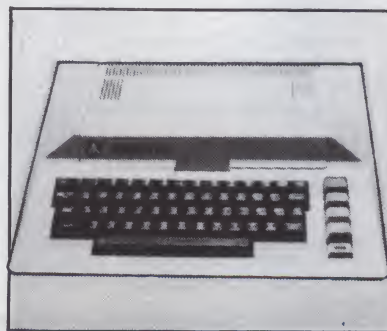
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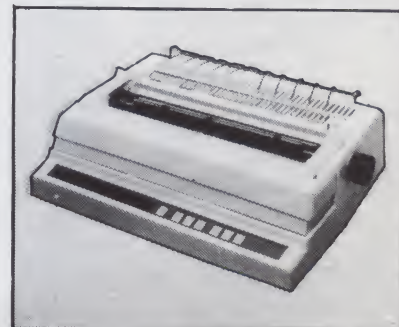
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## 6809 FLEX Versions

Although FLEX is a product of Technical Systems Consultants, several hardware manufacturers have licenses to modify it for their systems and sell the modified versions.

Although the terms of the license agreements specify that the modifications must be such that the modified systems must still be able to read and write standard unmodified disks and run standard software (such as TSC BASIC), the modified versions of FLEX will generally only run on the equipment they are designed for.

The two biggest FLEX licensees are probably SWTP and Gimix. SWTP modifications to FLEX concentrate mainly on making it compatible with all the various SWTP 6809 mainframes.

At present three different SWTP 6809 system configurations are supported:

The /09 system is generally a 6800 system with an MP-B or MP-B2 motherboard, which has been converted by the installation of an MP-09 board. Since this configuration uses the 6800-style motherboard (with modifications to move I/O from address 8000 (hexadecimal) to E000), I/O ports use four addresses per slot. Older, 6800-style I/O boards are used including the MP-S and MP-LA boards. This system does not use extended addressing, and is therefore limited to a maximum of 56K bytes of RAM.

The 69A and 69K systems are the assembled and kit versions, respectively, and use the newer MP-B3 motherboard. These systems are also limited to 56K of RAM, but use the newer I/O bus structure which devotes 16 addresses per I/O slot instead of four used on 6800 systems. For example, port 7 in the /09 system is at address E01C (hexadecimal), whereas in the 69K or 69A it is at address E070. This requires that the newer MP-S2 and MP-L2 interface boards be used. (Older I/O boards can be used with the new addressing modes, but not vice versa, since the new boards do not fit into the older mainframes.)

Finally, the S/09 system uses the even newer MP-MB motherboard. I/O ports again use 16 addresses per slot and require the newer I/O boards; in addition, this motherboard allows extended RAM addressing, so that a total of 384K bytes of memory can be used (consisting of three 128K

RAM boards). Since the extended address lines are placed on the bus pins formerly used by the data rate lines, data rate signals must be generated separately. This system therefore has an additional plug-in board called the MP-ID, which contains the data rate generator as well as a parallel output port and interrupt timer. This board

is located at address E080.

SWTP versions of FLEX include extra code (which is only run when the system is first booted) to test the system and set appropriate flags to indicate which system is being used. They also check the extent of memory (including testing for extended memory) and configure the dynamic

### How Readable Is this Article?

The June 1981 issue of *Kilobaud Microcomputing* had an interesting program, written by Richard R. Parry, for analyzing written text. The idea is to grade an article or other text to see how well it is written, and how well it might be understood by the typical reader.

A similar program (though written in assembly language and therefore much faster, as well as more complete) is available from the Frank Hogg Laboratory (130 Midtown Plaza, Syracuse, NY 13210). Written by Dale Puckett, the READTEST program is a very useful addition for anyone who does a lot of writing. (Dale Puckett also wrote the ESTHER program available from the Hogg Laboratory. ESTHER is similar to the well-known ELIZA program, but

much better than the usual microcomputer implementations).

READTEST reads a text file from disk, and analyzes it for content. It counts the number of words and sentences, as well as the types of words. After computing the average sentence length and other facts about the text, READTEST then prints out a short critique of how well it is written.

(Hm...if I were an English teacher, could I have my students type their papers into the computer, and then have the computer do the grading? Cute idea...)

To see how well this article stacks up (in its original form, before the editors fix all my mistakes), I ran READTEST on it. Listing 3 shows the program's output, which I'm including here without editing... and without comment.

```
Number of lines = 748
Number of words = 6628
Number of sentences = 377
Number of proper nouns = 458
```

Now counting personal words and affixes . . .

```
Number of personal words = 133
Number of affixes = 2834
Average sentence length = 17
```

Based on the average sentence length your rating is:  
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Listing 3.



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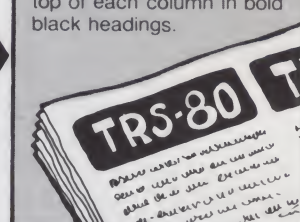
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address translator (DAT) on the processor board. These FLEX versions are currently supplied by SWTP only for newer disk controllers, and hence the required modifications to make them work with older disk controllers are described in several of the Application Notices.

Gimix versions of FLEX are also customized to fit their hardware. Gimix currently has three different disk controllers available, and so Gimix supplies three different versions of 6809 FLEX rather than trying to have one version support all controllers.

The 5/8 disk controller can be used with either 5-inch or 8-inch drives on 6809 systems, and with 5-inch drives on 6800 systems. On 6809 systems it can be used with two-sided drives as well as double-track drives (which provide 80 tracks per side), but only in single density. This is the simplest of Gimix's three controllers, but unlike some of the equivalent controllers of other manufacturers, this one has a data separator and somewhat better design. As a result it is far more reliable and does not require periodic disk re-reads.

The double-density programmed I/O (PIO) controller works only with five-inch drives on 6809 systems but allows double-density and/or double-sided and/or double-track operation. On a standard drive such as a Shugart SA-400, this controller provides 612 256-byte sectors for a total storage of 152K bytes in double density. Using an MPI model 92 drive, on the other hand, adds double-sided operation plus the capability to use 80 tracks on each side. This provides 2844 sectors of 256 bytes each, for a total of 711K per disk.

Finally, the DMA disk controller allows all of the above options, and uses direct memory access (DMA) data transfer instead of programmed I/O. The major advantage of DMA controllers is that they allow double-density operation on eight-inch drives without requiring that the CPU clock speed be raised to almost 2 MHz. Theoretically, this controller can be used on both 6800 and 6809 systems; practically, though, only the 6809 is supported by Gimix.

For my separate 6809 system I chose the double-density PIO controller along with a pair of MPI 92

disk drives. (It is staggering to realize that the resulting 1422K bytes of disk storage is more than that of the IBM 1130 computer I have used at work for the last ten years.) Though this controller and drive combination is more expensive than those used on my 6800 system, I made the choice simply because here, at last, was something the 6809 could do that my 6800 system could not.

Although these drives use both sides of each disk, I use standard single-sided disks (like the Verbatim MD-525-01) with no difficulty. In fact, I have no trouble using some disks that have been discarded by a TRS-80 user because they gave him too many errors. The Gimix controller is really very reliable even on such unusable disks.

The Gimix version of FLEX includes a number of extra utilities that are supplied by Gimix for their systems, such as commands to set and read the clock chip which is available on Gimix boards, or provide data to the arithmetic chip which is also on some processor boards. But it is the FLEX extensions that are most interesting.

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Instead of a NEWDISK utility, Gimix supplies a FORMAT program to format a blank disk. It prompts for a number of options, including single- or double-density operation, single or double sides, and the number of tracks to be formatted. This latter option is especially handy if you just need a few tracks for a temporary file, since formatting can take a long time for an 80-track, double-sided disk.

Another useful utility called SETUP is used to modify various drive parameters. As supplied, FLEX assumes that slow drives (having slow track-to-track movement) are used, but the SETUP utility can be used to change the speed at which FLEX moves the head to match the drive

used. This is particularly handy when several different drives are used, some slow and some fast. Another function is to tell FLEX how many drives are actually on the system, so that the system does not hang up if a nonexistent drive is specified in a command.

80-track drives are normally incompatible with 40-track drives, but Gimix FLEX can be configured to skip alternate tracks so that an 80-track drive can read or write a 40-track disk. This makes it possible to interchange disks with systems using other types of drives and controllers.

There is only one disadvantage I can think of in having so much disk storage (aside from the fact that one

gets very sloppy when there is so much empty room). Since it is possible to put hundreds of files on one disk, the directory grows large too. On FLEX, the directory starts on track 0, and so directory accesses are fast when the directory is small. But once there are more than a few dozen entries, the directory is continued on inner tracks, with the result that each directory read or write—of which there are many in normal operation—involves extensive head movement.

This can slow down operation quite a bit. Fortunately, Gimix supplies an EXTEND utility to extend the directory size. When used on a new, freshly-formatted disk, EXTEND adds up to ten more sectors to the directory. Since these new sectors

### SWTP Application Notices

The 6809 system takes just a few paragraphs to describe, but in reality it took months of experimenting to figure it out. And then I discovered that SWTP had issued some Application Notices describing this fix, as well as other fixes, and that I could have saved myself all this work if I had known about them.

Since I have discovered many other SWTP owners who do not know about these notes, here is a listing of what is available at the time of writing, though more Application Notices will probably exist by the time this appears in print. As I have been unable to get an index or the notes themselves from SWTP, I suspect that you will have to contact your local SWTP dealer for a copy.

Many of the changes or suggestions have been included with systems shipped after the date of the note, so even if a note applies to your equipment, it may not be necessary to get it unless the problem exits.

AN-101 (11-15-79). S/09 memory tests booting DMAF disks and system jumpers.

AN-102 (11-21-79). Using the DMF-2 controller on 6800 systems, or with Calcomp 143 drives.

AN-103B (10-31-80). Notes on using the CDS-1 hard disk.

AN-104 (12-13-79). Modifying the MP-09 CPU board into an MP-

09A board. If your CPU board works, then it has already been modified.

AN-105 (12-13-79). Notes on using the MP-09 or MP-09A CPU board in 6800 or /09 mainframes.

AN-106 (12-14-79). Using the DC-2 disk controller on MP-B3 or MP-MB motherboards.

AN-107 (1-2-80). Differences between SWTP 6809 systems, and patches to FLEX 9 versions 2.4 and 2.5.

AN-108 (1-8-80). Modifying the MP-S serial I/O board for printer handshaking.

AN-109 (1-8-80). 6809 software notes for the MP-R programmer.

AN-110A (2-14-80). How to use the Centronics 704 printer with SWTP computers.

AN-111 (1-23-80). More patches to FLEX versions 2.4 and 2.5 and notes on maximum file size.

AN-112 (1-25-80). Using serial printers with Multi User BASIC.

AN-113 (2-26-80). Using FLEX version 2.6 with the MP-B3 motherboard.

AN-114A (9-8-80). DMF2 controller address decoding, and operation with UNIFLEX.

AN-115 (4-25-80). Adjustments for Zenith monitors in some CT-82s.

AN-116A (7-2-80). Using the SWTP Editor with printer spooling, etc.

AN-117 (5-7-80). Modifying the 6800 MP-A CPU board for use with the DMF2 disk controller.

AN-118 (5-19-80). Notes on us-

ing the MP-S2 serial interface.

AN-119 (5-23-80). Testing 128K RAM boards with SBUG.

AN-120 (7-16-81). Unpacking and packing QUME eight-inch drives.

AN-121 (7-24-81). Notes on the CDS-1 hard disk.

AN-122A (11-14-80). Updating S/09 systems to work with FLEX or UNIFLEX. Updates MP-09 CPU board to revision C, MP-MP motherboard to revision A, and MP-ID board to revision C.

AN-123 (10-16-80). Patches to FLEX version 2.6 for Shugart drives.

AN-124 (10-21-80). Operating the S/09 at 2 MHz.

AN-125A (1-8-81). Using FLEX version 2.7 with the DC-2, DC-3 and DMF1 controllers, and Shugart or Calcomp drives.

AN-126 (11-6-80). Using the Centronics 737-1 printer.

AN-127 (12-10-80). Modifying the MP-09 and MP-09 CPU boards.

AN-128 (12-11-80). Modifying the CDS-1 power supply.

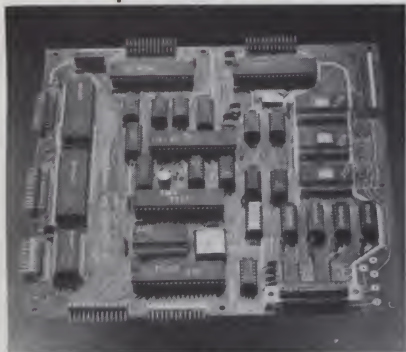
AN-129 (1-23-81). Modifying 128K RAM boards for 2 MHz operation.

AN-130 (2-17-81). Modifying 69/A and 69/K computers for 2 MHz operation.

I found several of the above notes useful, especially AN-127 that told me how to fix my MP-09 processor board. Also useful was AN-109, which provided information on using my MP-R 2716 programmer on the 6809 system.



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are on track 1, the disk head need move at most one track to get from the beginning of the directory to the end. Quite a difference.

## 6809 Advantages over the 6800

Having gone to a lot of effort to build a 48K 6809 system in addition to my present 50K 6800 system, there is the inevitable question of which I prefer.

The 6809 is potentially more powerful, but not without quite a bit of additional expense.

In the hardware area, my 6809 has about 1½ million bytes of storage with two disk drives. That could not be achieved with five-inch drives on my 6800 at all.

The real potential of the 6809, of course, is in the software. Until recently, most 6809 software was simply reassembled from original 6800 source code, and thus had very little advantage over the 6800. For example, I recently wrote a spelling-correction program called Magic Spell in 6800 code, and then reassembled it for the 6809. The 6809 version runs 10 or 20 percent faster, hardly enough to make much difference.

Now, however, more and more software is being developed strictly for the 6809. Though the change can be seen in all sorts of application software, it is most apparent in system software such as disk operating systems.

Though FLEX is by far the most popular, it does not really differ much from its 6800 version. But there are two other disk operating systems which run specifically on 6809 systems.

For big-system users (more than 64K) there is UniFLEX from Technical Systems Consultants (Box 2570, West Lafayette, IN 47906). This DOS is based on the famous UNIX system developed at Bell Laboratories, and is extremely capable. It is, however, definitely not for the small user. Not only is a very large amount of memory required, but the UniFLEX manual even suggests that each UniFLEX installation requires a system manager to oversee it, and larger installations may even require two such persons.

A much more accessible DOS for the small user (though very usable on large systems as well) is OS-9 from Microware Systems Corp. (5835 Grand, Des Moines, IA 50312). OS-9 is actually available in two versions—Level 1 for systems

under 64K, and Level 2 for systems over 64K.

Both UniFLEX and OS-9 support multitasking and multi-user software, which makes them ideal for the business user who may want to have several operators working on the same data files.

From the viewpoint of the hobbyist or personal computer user, their advantage is less clear. While it might sometimes be convenient to do two things at the same time (edit an article while running a big BASIC program, for instance), this is not so important to the small user.

A major disadvantage—at least from my point of view—is cost. Switching to a new DOS such as UniFLEX or OS-9 obsoletes all existing software. The cost of converting to either UniFLEX or OS-9, including a new DOS, BASIC interpreter, editor, assembler, text processor and perhaps other software as well, is in the area of \$1000.

Perhaps that explains why I decided to keep my 6800 system and build a separate 6809 system. The two systems give me the capability of running two programs at the same time, and do it more cheaply than completely switching to the 6809 and getting an advanced DOS. This way I have multitasking, multiprocessing, and multiprogramming (multi- being defined as two-).

Besides, I like the 6800. ■

## 68xx Bulletin Boards

There are currently three 68xx-based computer bulletin boards that I know of:

904-477-8783 in Pensacola, FL, is run by Don Wright, and uses a tape-based 6800 system. Runs close to 24 hours a day.

215-435-3388 in Allentown, PA, is run by Lehigh Press, and uses a disk-based 6809 system. Also 24 hours a day.

914-241-0287 in Mt. Kisco, NY, runs on either my 6800 or my 6809 system, whichever is free at the time. This number is answered either by me or an answering machine during the day; the bulletin board program runs evenings, usually until around midnight. If you have any comments or suggestions for future articles, that's a good way of getting them to me.

See you next time.



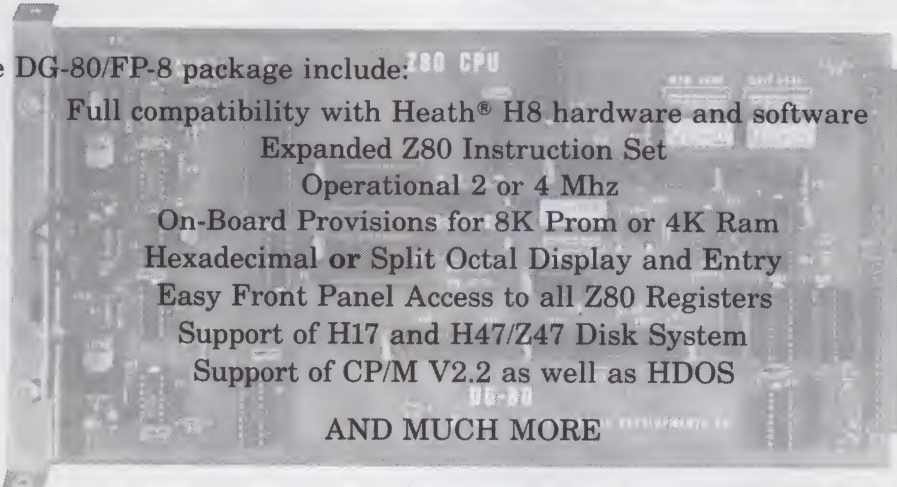
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# The Best of Both Worlds

By Gordon Wolfe

What a marvelous thing the computer is! It can take numbers and add or subtract them, multiply or divide, perform all manner of functions, store them, manipulate them and spew them forth in a torrent of paper. Any mathematical operation on numbers that can be conceived by man can be performed by the computer.

But where does the computer get its numbers to begin with?

Suppose you, like me, were a scientist doing experiments involving measurements of electrical quantities from some sensor device. In the simplest case, you would read the quantity from a meter, enter it into your data book and later key it into the computer for analysis. The numbers are generated by the keyboard.

But notice what happened—you've been reduced to an information collection and storage device for the computer. Computers should be our servants, not the other way around.

It would be much more efficient if the computer itself could obtain the numbers directly from the measuring device. After all, they're both electronic, aren't they?

It turns out that such a thing is possible, but that, generally, two such devices as a transducer and a computer are not fully compatible. The computer is a digital instrument, which recognizes only "on" or "off."

We live in an analog world—very few measurements are "yes" or "no" in nature. For example, the output of an X-ray detector might be 8.0 V, meaning that a 12,000 V X-ray en-

tered the detector. There are many other examples, such as the setting of a potentiometer or the output of a thermocouple, which give a voltage proportional to some physical value.

## The Conversion Process

This voltage must be converted to a series of on-off signals that a computer can understand. This process is called analog to digital conversion, and is the centerpiece of any computer measurement system.

There are several types of analog to digital converters (ADCs), with advantages and disadvantages to each. The single-ramp type is usually simplest and cheapest, but is slow in conversion and may suffer linearity problems (see my article "Innovative Tech's Analog-to-Digital Converter," p. 176, December 1980). Double-ramp is faster, but more expensive. Successive approximation is the fastest, most accurate and usually most expensive.

The type of ADC used must be

matched to the type of signal to be digitized. For dc signals, almost any type will do. For ac signals, such as speech recognition, a faster ADC will be required, with the speed requirement increasing with the ac frequency. Pulse height analysis, where you need to measure the maximum amplitude of a short voltage pulse, has one of the most difficult requirements. These types of pulses (Fig. 1a) are encountered often in science. In charge-particle physics, for example, a charged ion will deposit its energy (Fig. 1b) in a detector (which is really just a reverse-biased diode) and create electron-hole pairs, which are seen as a pulse of current across the diode. The height of the pulse gives a measurement of the energy of the ion.

The problem comes in measuring the maximum value of the pulse—how do you know when to take the measurement? Too soon or too late, and you miss the peak. Suppose your ADC has a conversion time of 500  $\mu$ s (microseconds), but the pulse is only

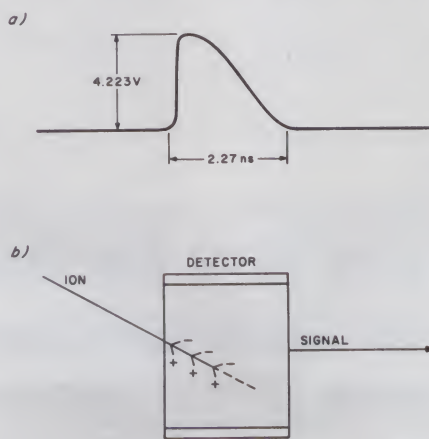


Fig. 1. a) Fast pulse whose amplitude is to be determined. b) Source of the pulse—an ion deposits its energy in a detector.

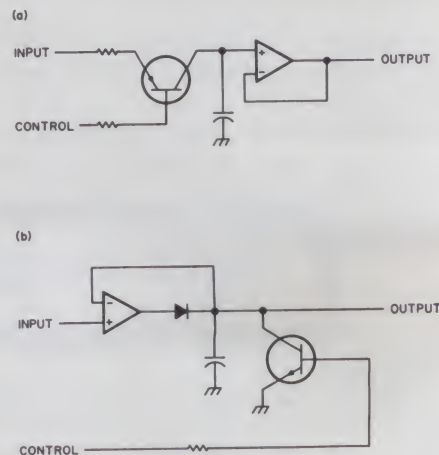


Fig. 2. a) Sample and hold circuit. b) Peak holding circuit.

Address correspondence to Dr. Gordon W. Wolfe, 1513 N. Sibley, Metairie, LA 70003.



2  $\mu$ s wide. What do you do then?

Usually, the matter is taken care of by signal holding. The voltage to be measured is placed onto a capacitor, with no means of leakage off until the measurement is finished. If this is to be done at a specific time, a sample and hold circuit is used. If you want to measure a peak, you use a peak sensor circuit. Fig. 2 shows examples of each of these.

Also, most ADCs have a comparator within them, which compares the input signal with some known fraction of a reference voltage. An ADC is only as good as the accuracy of the comparator and the precision of the reference voltage.

## An Application

The particular application I had was a combination of several types of data-taking, which required a fast "universal" analog-to-digital converter. My work at the University of Mississippi is research into the make-up, production and transport of air pollution. I do this by drawing large quantities of air through a filter, and analyzing the filter with X-rays. Sometimes the samples are liquified gases as well.

The X-rays arrive at random times, and are transformed into electrical pulses whose height must be measured. The energy spectrum is displayed on an oscilloscope in real time, and sometimes modifications to the acquisition routines must be made while the analysis is going on. This is done by interacting with the display via a joystick, whose value is

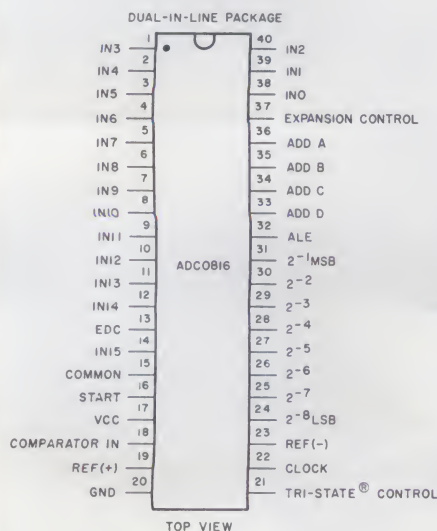


Fig. 3. Pin-out diagram of the ADC0817 (courtesy National Semiconductor).

displayed with the spectrum.

So I need to measure two channels of pulse heights at random times as needed by incoming data, two channels of dc voltages, on demand by the computer, and maybe one channel of temperature dc if liquid gases are involved.

What I really need, then, is an ADC that can do dc or pulse height, whose function can be started by the experiment or by the computer, with at least 256 channels of resolution (eight-bit output). With 5-V signals, this means accuracy to about plus or minus one millivolt. Also, I need a conversion time less than 100  $\mu$ s.

Such devices are on the market. One made specifically for the purpose outlined above sells for \$1650, and \$475 for the precision power supply. Too much for my pocketbook. I was determined to build my own.

I had begun to design such a device when I ran across an advertisement for the National Semiconductor ADC 0817 integrated circuit. (See Figs. 3 and 4.) This chip is designed to be the centerpiece of a data acquisition system such as mine. It has eight-bit resolution with tri-state outputs, fast successive approximation conversion methods and a 16-channel analog data multiplexer so that up to 16 analog channels may be digitized. Best of all, it has a conversion time of only 90  $\mu$ s at the 875 kHz clock rate I use, and a whole acquisition system may be constructed for less than \$70.

The circuit I eventually came up with is shown in Fig. 5. Fifteen of the sixteen analog inputs are usable. Seven inputs are controllable by external strobes, and eight are controllable by the computer through data lines PA4 through PA7. The only

ADC  
SSB MNEMONIC ASSEMBLER PAGE 1

NAM ADC  
OPT NOP

\*  
\*HANDLER FOR ADC0817  
\*CIRCUIT WITH 15 COMPUTER  
\*SELECTABLE INPUTS, 7  
\*EXTERNAL SELECT INPUTS

A020 XTEMP EQU \$A020  
\$018 PIAADC EQU \$0018

\*  
DA00 ORG \$DA00

\*  
\*ROUTINE TO CALL DATA  
\*INPUT CHANNEL  
\*CHANNEL NO IN A

DA00 81 0E CALDAT CMP A #14  
DA02 2E 60 BGT ERROR  
DA04 48 ASL A  
DA05 48 ASL A  
DA06 48 ASL A  
DA07 48 ASL A  
DA08 B7 0018 STA A PIAADC  
DA09 86 FF LDA A #FF  
DA0B B7 0018 STA A PIAADC  
DA10 3E WAI  
DA11 39 RTS

\*PIA INITIALIZATION  
\*A SIDE 0-3 INPUT  
\*A SIDE 4-7 OUTPUT  
\*B SIDE INPUT  
\*CB1 INTERRUPTS ON  
\*HIGH TO LOW TRANSITION

DA12 CE 0018 ADCSET LDX #PIAADC  
DA15 6F 00 CLR 0, X  
DA17 6F 02 CLR 2, X  
DA19 86 F0 LDA A #F0  
DA1B A7 00 STA A 0, X  
DA1D 6F 02 CLR 2, X  
DA1F 86 04 LDA A #04  
DA21 A7 01 STA A 1, X  
DA23 86 05 LDA A #05  
DA25 A7 03 STA A 3, X  
DA27 39 RTS

\*  
\*INTERRUPT SERVICE ROUTINE  
\*EXECUTES ONE OF 15

\*DEPENDENT ON ADDR  
\*IN PIAA 0-3

DA28 TABLE EQU \$D900  
DA28 D9 00 ROUT0 FDB \$D900  
DA2A DA 60 ROUT1 FDB DONE  
DA2C DA 60 ROUT2 FDB DONE  
DA2E DA 60 ROUT3 FDB DONE  
DA30 DA 60 ROUT4 FDB DONE  
DA32 DA 60 ROUT5 FDB DONE  
DA34 DA 60 ROUT6 FDB DONE  
DA36 DA 60 ROUT7 FDB DONE  
DA38 DA 60 ROUT8 FDB DONE  
DA3A DA 60 ROUT9 FDB DONE  
DA3C DA 60 ROUTA FDB DONE  
DA3E DA 60 ROUTB FDB DONE  
DA40 DA 60 ROUTC FDB DONE  
DA42 DA 60 ROUTD FDB DONE  
DA44 DA 62 ROUTE FDB DONE  
DA46 DA 62 ROUTF FDB ERROR2

DA46 0F DATAIN SEI  
DA47 B6 0018 LDA A PIAADC  
DA4A 84 0F AND A #0F  
DA4C CE DA28 LDX #TABLE  
DA4F FF A020 STX XTEMP  
DA52 48 ASL A  
DA53 B8 A021 ADD A XTEMP+1  
DA56 24 03 BCC SERVE  
DA58 7C A020 INC XTEMP  
DA5B FE A020 SERVE LDX XTEMP  
DA5E AD 00 JSR 0, X  
DA60 0E DONE CLI  
DA61 3B RTI

DA62 20 FC ERROR2 BRA DONE  
DA64 39 ERROR RTS

\*  
END  
NO ERROR(S) DETECTED

SYMBOL TABLE:  
ADCSET DA12 CALDAT DA00 DATAIN  
DA46 DONE DA60 DA62 PIAADC  
ERROR DA64 ERROR2 DA28 ROUT3  
\$018 ROUT0 DA30 ROUT8  
ROUT1 DA2A ROUT2 DA34 ROUTB  
DA2E ROUT4 DA38 ROUTC  
ROUT6 DA32 ROUT7 DA40 ROUTD  
DA36 ROUT9 DA42 ROUTF  
ROUTA DA3A ROUTB DA44 SERVE  
DA3E ROUTD DA46  
ROUTE DA42 ROUTF  
DA5B TABLE DA28  
XTEMP A020

Listing 1. ADC program for a 6800-based system.



IC5 is the precision voltage reference for the ADC. It is an analog devices AD584 chip, and can be programmed for 10.000, 7.500, 5.000 or 2.500 V, plus or minus one millivolt. It is essentially a precision, low-power voltage regulator. You might be tempted to use this chip as a power supply for the whole conver-

IC1, IC3 and IC4 sense that a data

conversion is required, either by the computer or by the incoming data, and set the address latch onto the ADC so that the correct analog input may be used. Inputs 8-14 may be accessed by the experiment directly, while inputs 0-14 may be accessed by the computer. IC2 starts the conversion process whenever a high-to-low transition is seen at any of its inputs, assuming that all were high to begin with. The 2N2222 transistors on the inputs of IC1 are invert-buffers. In my applications, the "data present" strobe is usually +10 V, and these invert the signal and convert it to TTL levels. IC1 is a priority encod-

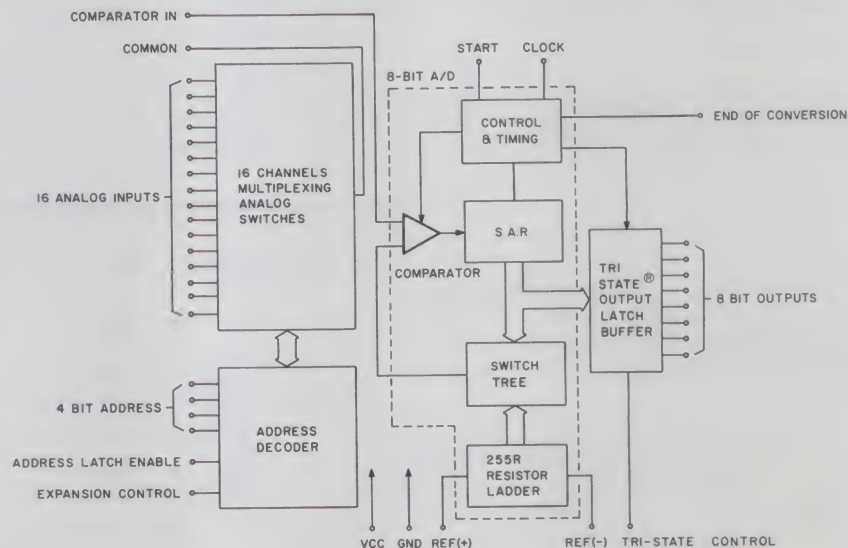


Fig. 4. Block diagram of the ADC0817 (courtesy National Semiconductor).

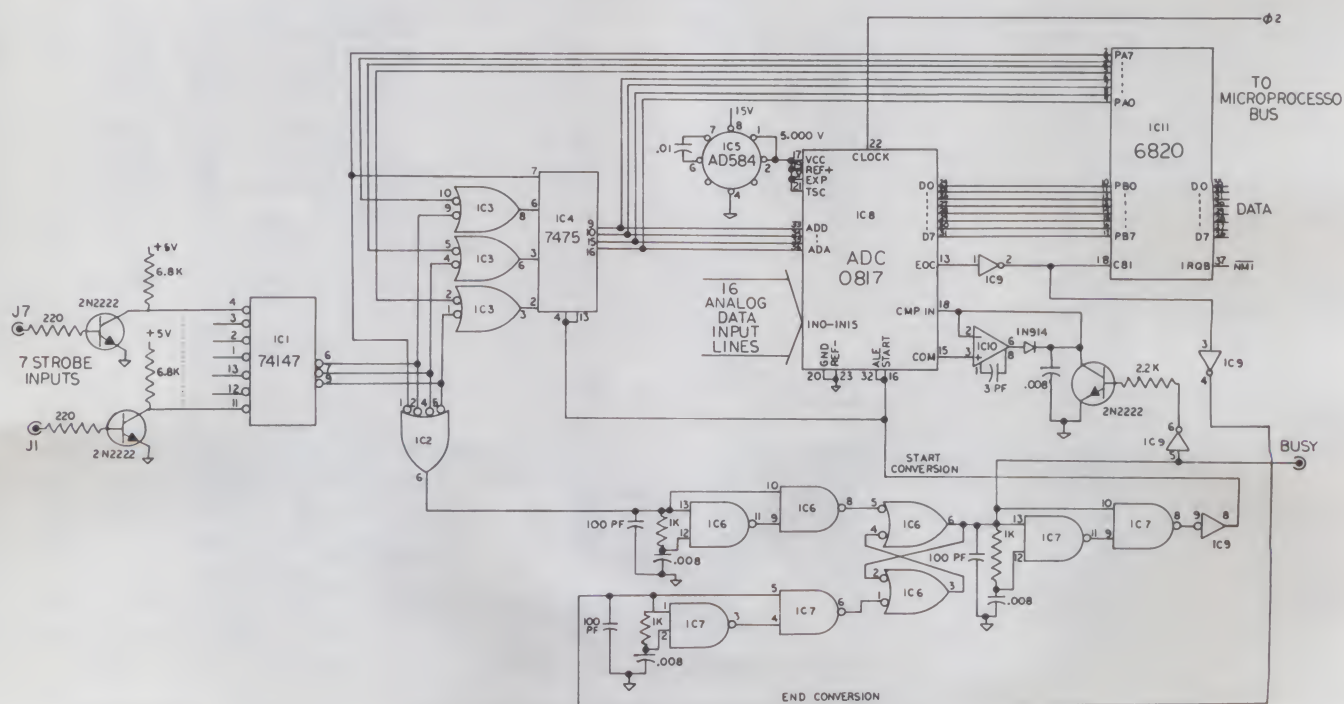


Fig. 5. Circuit diagram of ADC0817 in use in present work.



er so that J1 has highest priority; the most important signals should go on to J1. If a signal is present at J2, and a signal comes into J1, the conversion will switch to J1.

A four-bit code is sent to the processor via the lowest four bits of the A-side of the 6820 PIA to tell the computer which input of the ADC is being converted. This is necessary for one of the strobed inputs, and is a good confirmation that the correct computer-controlled input is being accessed. To access an input, simply output the four-bit address of the input channel through the higher four bits of the A-side of the PIA.

Notice that we are using the PIA as 12 inputs and four outputs. The 6820 is designed so that all bits of either side can be programmed by the computer to be either input or output. In this case, the B-side is all input, while the A-side is half input and half output.

Users of SS-50 systems who have the MP-LA parallel input/output card must make a minor change in the card. This card is set up so that all of the B-side is input and all of the A-side is output. Cutting two tracks

and adding two wires, as shown in Fig. 6, will reverse the buffers on the lowest four bits of the A-side and make those four bits inputs. A DPDT switch can be glued to the card to switch back and forth.

Lastly, the converter is dependent upon a high-frequency square wave clock, which is to be input to pin 22 of the ADC 0817. This clock should be between 600 kHz and 1200 kHz. In my SWTP 6800 system, I simply use the 875 kHz 01 clock line.

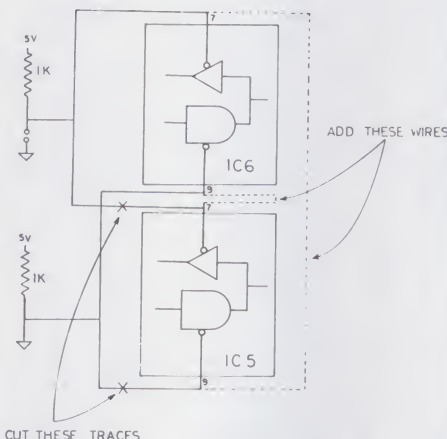


Fig. 6. Modifications to the MP-LA output port.

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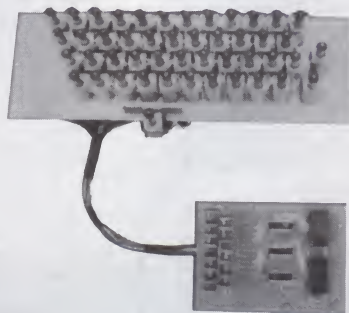
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Since the converter is designed to digitize data which arrives at random, unpredictable times, the converter has been set up to cause an interrupt in the processor. In the case of a 6800-based machine, this should be a non-maskable interrupt (NMI). The output of pin 37 of the PIA should be tied to the NMI line of the processor bus.

## ADC Programs

The software used with the con-

verter should reflect the 15-input nature of the converter, and should also be able to be used as an interrupt service routine, since the end-of-conversion signal causes an interrupt. An example of the type of software to be used in 6800-based systems is given in Listing 1.

This software is in two major parts: Routine CALDAT at \$DA00 is a subroutine which puts out a number between 0 and 14 from accumulator A

to begin a conversion on data lines 0 to 14. The routine starts the conversion, waits for the data, services the interrupt, and returns to the calling program. The other routine, DATAIN at \$DA46, is the interrupt service routine. The routine accepts the data from the PIA, gets the address of the input channel in box, and branches to one of 15 service routines to store the data or operate on it. A different routine is provided for each of the 15 usable channels, since the usual procedure will be that each channel means something different.

An example of such a service routine is given in Listing 2. In this case, a histogram is generated, to give the number of times a specific voltage is seen versus the voltage itself. If the voltage measured corresponds to, for example, the energy of an X-ray, then the histogram is a plot of the number of X-rays seen vs energy of X-rays. Such a histogram is plotted in Fig. 7.

If you use the program above, or a similar program, with your machine, be sure that the nonmaskable interrupt vector is programmed to transfer control to the interrupt service routine DATAIN.

IC No.	Type	+5 V Power	Ground	+15	-15
1	74147	16	8		
2	7420	14	7		
3	7400	14	7		
4	7475	5	12		
5	AD584	—	4	8	
6	7400	14	7		
7	7400	14	7		
8	ADC0817	—*	20,23		
9	7404	14	7		
10	LM310A	—	—	7	4
11	MC6820	20	1		

\*See Text

Table 1. Power and ground connections for integrated circuits.

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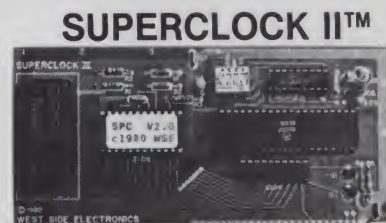
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The programs above are not relocatable nor re-entrant, and may not be placed in EPROM, since they are self-modifying. It would have been easy to write the routines to meet these criteria, but speed of execution would have suffered greatly. Since my uses require up to 1000 conversions per second, the speed of the ser-

vice routine is paramount, or data will be lost. The creative programmer with less stringent requirements can easily rewrite the programs to his own needs.

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```

HISTO
SSB MNEMONIC ASSEMBLER PAGE 1

      NAM      HISTO
      OPT      NOP

*
*INTERRUPT SERVICE ROUTINE
*TO CREATE HISTOGRAM
*OF FREQUENCY VS CHANNEL
*
D900      ORG      $D900
D800      HISTGM EQU $D800
8018      PIAADC EQU $8018
*
D900 B6 801A      LDA A PIAADC+2
D903 B7 D90A      STA A JUMP+1
D906 FE D800      LDX HISTGM
D909 6C 00      JUMP INC 0,X
D90B 39          RTS

      *
      END
NO ERROR(S) DETECTED

```

Listing 2.

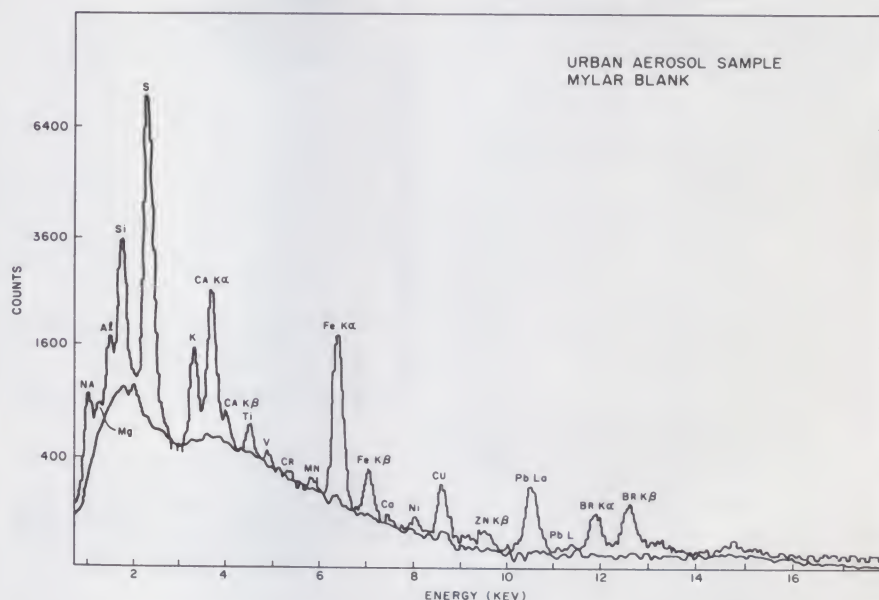


Fig. 7. Histogram of frequency of occurrence of a given value of the ADC data vs the value of the data. To be specific, in this case, X-ray intensity vs X-ray energy. Notice the peaks showing up nicely, corresponding to characteristic X-rays of a given element.

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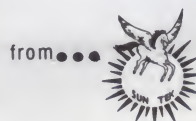
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three	twenty	case	equal	it	off	set	e		
four	thirty	cent	error	kilo	on	space	f	w	
five	forty	400hertz	tone	feet	left	out	speed	g	x
six	fifty	80hertz	tone	flow	less	over	star	h	y
seven	sixty	20ms	silence	fuel	lesser	parenthesis	's	start	i
eight	seventy	40ms	silence	gallon	limit	percent	stop		
nine	eighty	80ms	silence	go	low	please	than	k	
ten	ninety	160ms	silence	gram	lower	plus	the	l	
eleven	hundred	320ms	silence	great	mark	point	time	m	
twelve	thousand	centi	greater	meter	pound	try	n		
thirteen	million	check	have	mile	pulses	up	o		
fourteen	zero	comma	high	milli	rate	volt	p		
fifteen	again	control	higher	minus	re	weight	q		
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alert	crease	fourth	more	receive	test
all	"de"	forward	move	record	"th"
ask	deposit	from	next	reverse	thank
assistance	dial	gas	no	red	third
attention	door	get	normal	repair	this
blue	east	going	north	repeat	turn
brake	"ed"	green	not	replace	under
button	emergency	hale	notice	room	use
buy	enter	heat	open	safe	waiting
call	entry	hello	operator	second	warning
called	"er"	help	or	secure	was
caution	"eth"	hurts	pass	select	water
celcius	evacuate	hold	per	send	west
centigrade	exit	hot	power	service	wind
change	fail	press	side	slew	window
circuit	failure	incorrect	pressure	slow	yellow
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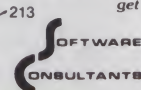
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# Japanese Invasion: Part IV

By G. Michael Vose

**I**t does not now appear that the Japanese are going to flood the small computer market with awesome machines priced like fast food—at least not for a year or more. The computers reviewed in Parts I, II and III of this series (the Casio FX-9000P, September, p. 101; the Sharp YX-3200, October, p. 90; and the NEC PC-8000, November, p. 110) are

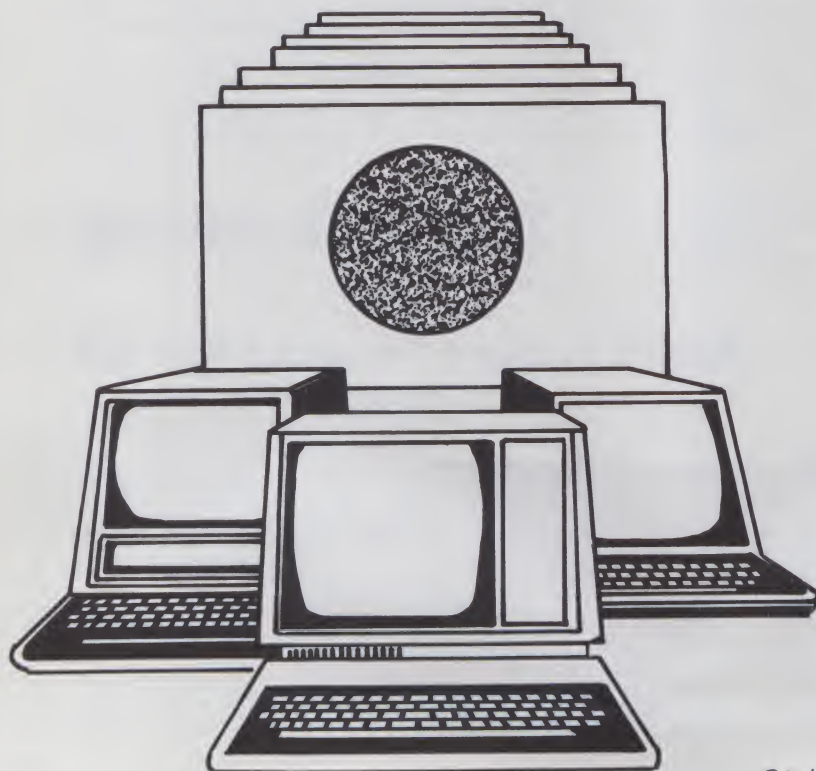
expertly designed and well-made but are not appreciably better than homegrown machines. And while they are competitively priced, they do not significantly undercut the prices of American manufacturers. So how do we evaluate the invasion we speak of in the title of this series?

Ultimately, the Japanese may overwhelm the American market by

sheer number—number of manufacturers and number of machines. The Japanese, in spite of the seeming socialistic benevolence of their industrial organizations, are fiercely competitive. This is true of the worldwide marketplace, but it is especially true in Japan. While most Japanese companies would like to be among the top companies in the world, they would like even more to be number one in Japan. This competitiveness, combined with Japanese electronic expertise, will guarantee that the peoples of this small Far Eastern island will be responsible for significant advances in computer technology.

## Many Little Companies All in a Row

Our series so far has looked at new computers from three of Japan's most aggressive electronics conglomerates. A survey of the industry in Japan reveals, however, that no fewer than 25 companies are manufacturing and selling micro- and mini-computers. Several of these firms also market mainframe computers. These machines cover the gamut from a unit with a 4K byte user memory and a Z-80A CPU to units with a



*R. Dukett*

---

*G. Michael Vose is a technical editor for Microcomputing.*

---



256K byte user memory accessed by a 16-bit Intel 8086 processor. In-between are units with twin 6809 CPUs to computers designed around the Motorola 68000 processor that can function in either a 16-bit or a 32-bit environment.

Interestingly, the Japanese have never used the 6502 CPU in mass-marketed machines. The Motorola, Intel and Zilog microprocessors have been the building blocks for Japanese engineers.

The names of many of the Japanese companies now making microcomputers—Canon, Casio, Hitachi, NEC, Sanyo, Seiko, Sharp, Toshiba—are familiar to both Americans and Europeans. Others such as Oki, SORD, Anritsu and Densan are less familiar. They all have a common thread, however—a history of manufacturing success and some experience with electronics. This is in direct contrast with the American method of building hardware.

In the U.S., a new hardware idea usually means a new company. A new company very often is started by an engineer with a great new idea, very often with a prototype of the hardware system he has designed. The engineer usually doesn't know much about marketing, manufacturing, organization and the other components of business operation. Unless he can find and afford competent, knowledgeable managers, his project may never succeed. The idea may eventually catch on, but often the engineer who developed it loses out.

In Japan, the engineer is committed to the company he works for. A great new idea makes the company look good and, as a result, many people benefit. The manufacturing and marketing support are in place to assure the successful implementation of the technology. The risks are shared as well as the rewards.

In America, established electronics firms such as RCA, Sylvania and Magnavox have made no attempt to develop new technology like computers. Even Radio Shack, the electronics firm that made available the first low-priced, mass-marketed microcomputer, took on the new project with skepticism and with no expectation of success. Radio Shack did not commission the development of the first TRS-80: it merely bought the idea after the fact. Zenith Corporation acquired Heath Company after

its computer had been developed—this deal was struck more for economic reasons than any other.

What does this mean to the long-range future of the microcomputer market and the Japanese role in it? The Japanese have demonstrated that they have the expertise to make a quality small computer. In just the four years since the Apple and TRS-80 were developed, the Japanese have developed the Sharp Business Computer and the NEC PC-8000. These machines are just as good as their American counterparts and only slightly more expensive.

The Japanese have heard the cry, "What about software?" and are striking deals with software companies and making machines that are compatible with existing operating systems and software libraries. The Japanese are skilled in marketing concepts. (For example, NEC has just announced that its new PC-8000 system will be sold by the new Sears Business Systems Centers, which began opening around the country in October.)

The Japanese are capable, competi-

tive and have a strong industrial base. They will obtain a share of the market and will develop new and better machines.

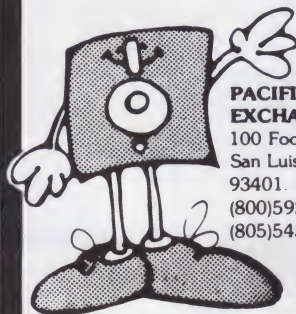
## The Invasion Continues

Ironically, the rapidly growing Japanese presence in the microcomputer marketplace has the effect of confusing an already blurred landscape. The prospective buyer of computer equipment, whether a businessman or a home-computer buyer, must wade through an expanding selection of units, all claiming to be the best. Ten years from now, the chore will be easier because many shoppers will know what they want or need and will be able to narrow the field before they start. But today, many people know that they want or need a computer, but they are not sure why.

And the selection grows. Sharp Corp., in addition to its YX-3200 Business Computer, markets the MZ80B in Europe. Oki Corp. sells the IF800 (Models 10, 20), a Z-80 based machine with 48K bytes of user memory, 8K bytes of prepro-

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grammed systems memory and graphics with color capability. Matsushita Company offers the Mybrain 850M monochrome display computer operating with an 8085 (eight-bit) processor and featuring 56K bytes of user memory.

Densan Co. Ltd. makes available a terminal-dependent unit called the DSC-80ZA, containing a Z-80A or 8088 (eight-bit) processor. Canon offers a pair of 6809-based machines, the BX-3 and CX-1, each with 32K bytes of user memory.

Other manufacturers now selling microcomputers only in Japan are eyeing the rapidly developing American market. TEAC sells a Z-80A-based, 48K byte monochrome display microcomputer; Hitachi offers a 6809-based color computer with 64K bytes of user memory for the equivalent of \$1355; and Sanyo wants to become the OEM for any American firm interested in offering a 64K byte memory microcomputer fired by dual 8085A processors.

Most of the Japanese microcomputers contain a BASIC language interpreter and many offer optional pack-

ages to allow the use of COBOL, FORTRAN and Pascal. Many have operating systems similar to and compatible with CP/M. Most are S-100 bus constructed, assuring portability and compatibility with other computer systems.

The Japanese are diligent; they know what other people are doing and they are quick to adapt to what they see as a standard.

### Who's the Best?

Is there someone who can tell you which computer is right for you? Only one—you! The name of the game is figuring out what you want to do, now and in the future, and then looking at machines and software that will do the job for you. Don't be afraid to be subjective—looks and ergonomics are as important as maxibytes and operating systems, color and graphics as important as price and serviceability. There seems to be no easy way to choose—it is helpful to learn as much as you can about machines with a big reputation (see the IBM and Xerox reviews elsewhere in this issue).

It is true that the computer you buy today will no doubt be dwarfed by the computers of tomorrow. But if today's computer does its job, it is nevertheless a valuable tool. The Japanese intend to see that you get a broad and capable choice.

### The One Question

The Japanese do have one weakness that will affect their impact on the American market. They do not have the resources to produce innovative software for the U.S. consumer. The experience of VisiCalc and its effect on the sales of the Apple Computer, the first computer for which it was written, is a classic example of how top-quality software can boost hardware sales. While there is no way to evaluate this phenomenon, there is no question that software support helps to sell hardware.

If the Japanese can entice top software producers into writing for them, they will significantly enhance the market for their machines. Then it will be time to evaluate the Japanese Invasion, Phase Two. ■

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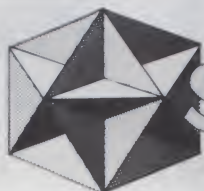
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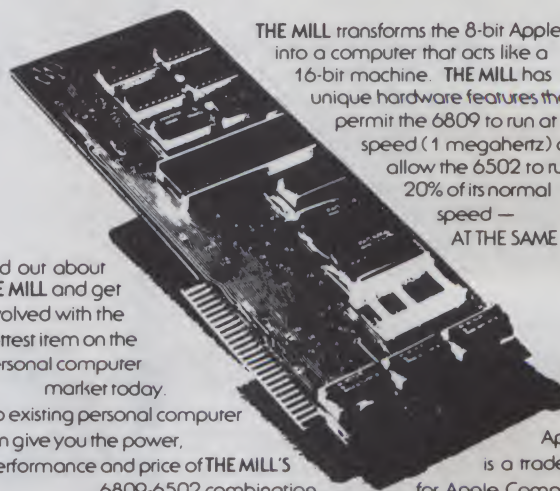
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# Relief for an Overstuffed SWTP

By Dennis Doonan

**I**t was bound to happen. My SWTP 16800 chassis was filled. Even the eight I/O slots were filled with boards. While it is nice to have a full system, it is uncomfortable to know future expansion will cause drastic changes.

I could replace three memory cards with a single 32K card. This would open two main slots and ease the load on the power supply, but the cost of

replacing three reliable products would be hard to justify.

The only sensible alternative was to expand the motherboard. The procedure is described in the SWTP system manual; just buy another motherboard and connect it in parallel with the existing one.

This sounds simple, but there are two problems. SWTP no longer makes the MP-B2 motherboard. Even if a used one could be found, it would have the same I/O addresses as the first one. Rewiring would be necessary. See the April 1980 issue of *Microcomputing* ("The SWTP Com-

puter System," p. 136) for an explanation of the re-addressing procedure.

The decoding on both boards would also have to be changed or a full 8K of address space would be needed for the I/O ports. This couldn't even be considered on a system limited to 64K.

About the time I was faced with these problems, Quality Research Company (PO Box 7207, Spokane, WA 99207) announced their 80-210 motherboard for the SS-50 bus. It was designed with expansion capability in mind.

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Address correspondence to Dennis Doonan, c/o Graphics I, 345 Main St., Racine, WI 53403.

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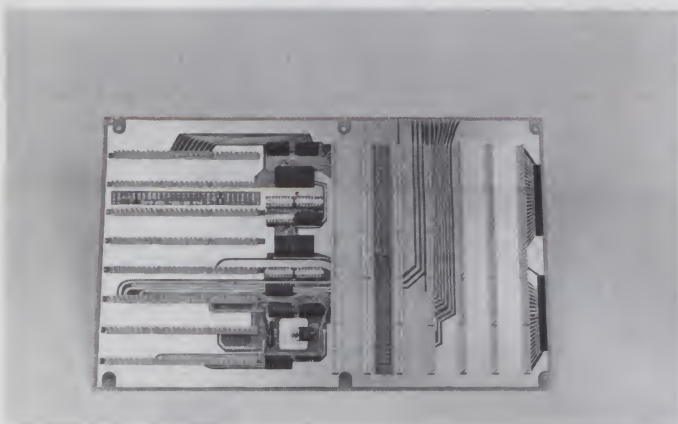


Photo 1. The completed QRC 80-210 motherboard. It can be used as is for a single system or used as an expansion motherboard.



Photo 2. The extender card that fits onto the existing SWTP chassis. The two ribbon cables go to the QRC extension board. This is the back view of the board.



## The Package

The QRC 80-210 is a double-sided, plated-through board physically compatible with the SWTP motherboard. It provides seven main 50-pin slots and eight fully decoded 30-pin I/O slots. All of the data, address and control lines have interbus shielding and buffering. There is even ground plane shielding on the top of the board. These shields provide the lower signal noise level essential for expansion.

The price of the 80-210 bareboard is a reasonable \$39.50. QRC provides the pin connectors for an additional \$20.

The QRC documentation is clear and concise. It gives assembly instructions, a parts layout, schematic and theory of operation.

## Connection

Assembly takes about one hour, but care should be used to keep the pin connectors straight when soldering. If they are installed at an angle, it is difficult to insert boards. It is best to solder each end of the individual 10-pin connectors and make sure they are straight before soldering the rest of the pins.

The board is delivered with the I/O addressed at 8000 (hex). Since the eight four-byte I/O ports are fully decoded, they use only 32 bytes of the memory map and can be addressed to any location.

The I/O address decoding can be selected by jumpers or DIP switches. The switches allow easy reconfiguration if a 6809 processor card is ever installed.

The I/O ports on the SWTP 6800/2 use partial decoding. The 32-byte address pattern is repeated after 32 bytes of free address space for the entire 4K block. The easiest way to use the QRC board is to address its I/O at \$8020 so it fits between the addresses used by the SWTP motherboard. There are now 16 I/O ports available on the system.

Ports zero through seven can be used without modifying existing software. If the other eight ports are needed by a high-level language such as BASIC, they can be called from a machine-language routine (the user function in BASIC).

The 50-pin bus of the 80-210 is expandable through two 50-pin standard connectors (AMP 2-87227-5) on the front edge of the board. Two 50-wire ribbon cables go to the sec-

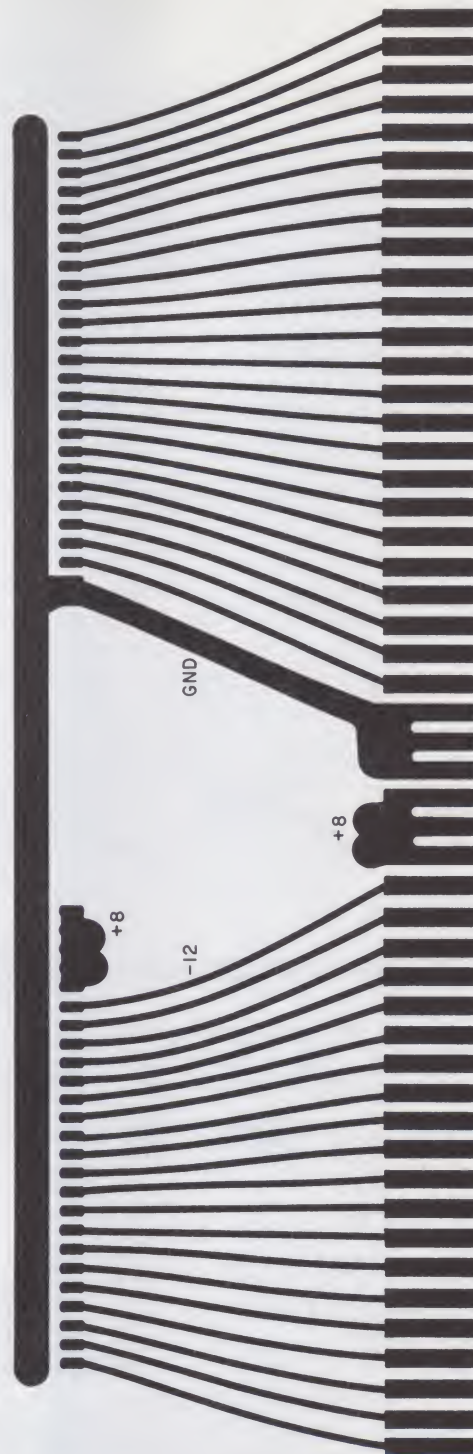
Fig. 1. This is a full-sized etch guide that can be used for etching the extender card. The center points for drilling are not included on this layout.

ond motherboard. While SWTP recommends #18 wire for the extension, ribbon cables will be adequate if they are kept short.

The only problem remaining is to connect the cable to the SWTP motherboard. The wires can be soldered directly to the original motherboard, but it is easier to use a short extender card ending in an AMP connector matching the ones on the QRC board.

Fig. 1 is a full-size etch guide for the extender. Conventional Molex connectors are used at the bottom and two AMP pin connectors are used at the top. The +8 V line is not connected. A jumper may be installed if needed.

If your original power supply is not overloaded, it can power the expansion motherboard. Power and control lines are brought to the side of the





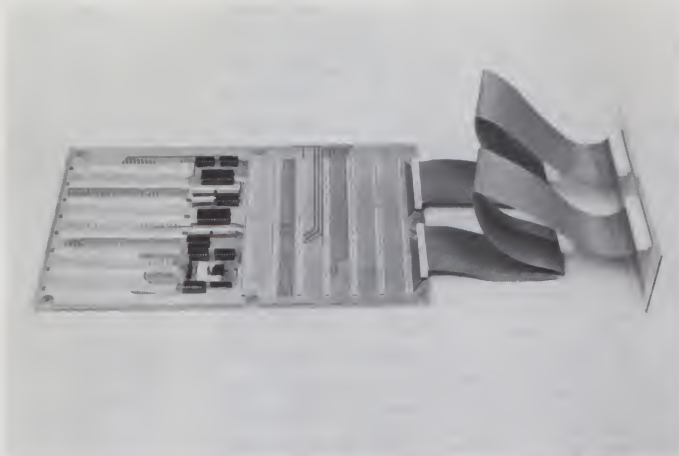


Photo 3. This is the unpopulated QRC motherboard and extension cable/extension card ready to plug into the SWTP.



Photo 4. The QRC motherboard as it arrived with bare board documentation and pin connectors.

QRC board. The power supply should be connected directly to these points rather than through the extension cables.

If your system's power supply is weak, a second supply can be connected to the expansion motherboard. If this is done, cut the +12 and -12 V traces on the extender board. Be sure the ground leads are connected between the two boards.

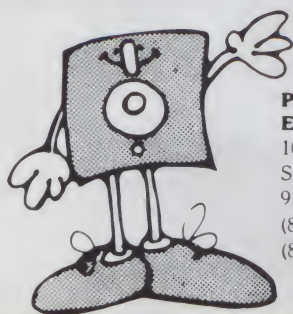
When using the ribbon cables, be sure the connectors are seated properly to ensure a tight fit. Also, before applying power, be certain the connection between the two boards is correct. If either the extender or the cables are inserted incorrectly, a great deal of damage could be done. This caution is necessary since the extender card was designed to have the foil traces on the top of the board.

This allows more room in the chassis.

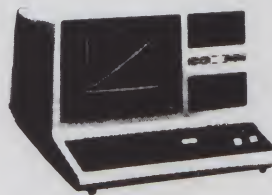
The expansion is definitely worth the trouble. It is now possible to use old 4K memory boards and address them to unused areas such as 9000. I/O boards and custom interfaces can be added without removing existing boards. The Quality Research Company's 80-210 has proved to be a reliable, reasonably priced solution to system expansion. ■

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# In Search of the Perfect Z

By Gene Embry

**T**he Z-charting technique for evaluating the performance of a business is rather obscure. But once you understand Z-charts, a quick glance will reveal several basic facts about the performance of a company. Programmers will find it an intriguing method of manipulating data arrays.

Fig. 1 shows a Z-chart. The vertical axis is labeled Dollars and the horizontal axis is Time. The bottom horizontal bar of the Z is a plot of the planned monthly bookings. The top bar of the Z shows the accumulated bookings for the past 11 months plus this month's bookings. The diagonal shown as the dashed line represents the year-to-date (YTD) planned bookings. The diagonal shown by the solid line represents the YTD bookings. In the very unusual case where bookings are equal to the plan, then only one line would be shown for the diagonal.

A programmer might think of the Z-chart as a 4 × 12 data array—12 data points for each part of the Z-chart. For each month there may be up to four different data points.

The interpretation of the Z-chart *deals* with the shape and not with the absolute values. Consider the four cases that are shown in Fig. 2. The first Z-chart, Fig. 2a, represents a no-growth company where the monthly plan and monthly bookings are the

same, year after year. Fig. 2b shows a growing company with a monthly increase of about 5 percent and with monthly bookings equal to the plan. The third, Fig. 2c, shows a company with a planned declining situation. This might represent a planned withdrawal from a marketplace. The final example, Fig. 2d, shows a situation where bookings are lagging the plan by about 50 percent, a very unhealthy situation. The demise of this company is near. (These four cases should serve only to introduce you to Z-charts, and not all possible situations.)

The business with a perfectly shaped Z, Fig. 2a, would not be given a perfect 10 by those with business acumen. But today's managers generally stress growth while maximizing gross return on net investment (GRONI). Current business theories are generally based on a time when our society was primarily oriented toward manufacturing. Within the last two or three years, we've become mainly service-oriented. Could it be that yesterday's theories are only partially correct? A normal Z (Fig. 2a) may, in fact, be a reasonable and desirable goal. If you can take \$100,000 out of your business, year after year, and you are satisfied, why shouldn't that business be considered healthy?

Note the positive slopes in Fig. 2b for the growth company and the negative slopes for the declining business in Fig. 2c. Fig. 2d shows convergence

of the two bars, indicating aggressive planning but declining bookings.

These four examples show that several important aspects of a business may readily be attained from a Z-chart. Two items not initially apparent from the Z-chart are the increased need for cash when the bookings begin to outstrip the plan, and the need to replace the planners or salesmen when bookings lag the plan by some unacceptable amount.

You don't need to restrict the vertical axis to dollars. It might be anything that is important to your business; e.g., the number of pages of advertisements in a magazine or productivity (dollars invoice per employee) time.

The program, ZCHART.BAS (Listing 1), can do much more than plot a Z-chart. It will let you start your own company and insert your own monthly plan and bookings for a 20-year period. You can automatically generate 20 years of data based on random numbers. You can list the entire 20 years of data or just one year's data. Further, you may save the data on disk or retrieve it from disk.

I've written the program in a modular form so that you can select only those portions you want to use. If you don't have a disk, you can insert a subroutine, starting at line 5000, to get your data from magnetic tape or from data statements.

Each of the seven main subroutines begins on a line number that is an in-

---

*Address correspondence to Gene Embry, Route 1, Box 151-H, Morrisville, NC 27560.*



teger of 1000 and returns on a line number that is an integer of 1000 plus 90. I'll first discuss the program initialization process and the generation of the main menu section, and then describe each of the seven major sub-routines. The program is fairly well documented with remark statements, so I'll only describe certain items in the program that are interesting or a bit unusual.

### Initialization

The program variables are initialized by the call to routine 9800. The main function of this routine is to dimension the arrays and assign certain variables. A listing of the major arrays and variables are shown in Table 1.

During this section, you are prompted to input the y-axis resolution. Your answer to this question determines the size of the plotting ar-

ray, Z(R,12). Since the program provides for automatic scaling of the y-axis, your answer will, in effect, determine the length of the y-axis. If you exceed the size of your read/write memory, then the error trapping section, line 9990, will be invoked.

The main menu is displayed via lines 100 to 140. Your selection is requested and the particular subroutine is called from lines 170 to 199.

**MAKE DATA—1000.** If you elect to generate some random data, this section is called. We give a "seed" of \$10,000 to the company in line 1004 to start off the generation of the 20 years of planning and bookings. Each month's plan is based on the past month's bookings within the limits established by line 1110. This gives a probability of a 6 percent decrease or a 14 percent increase in next month's plan. The bookings for a month are based on the plan for the current month. As shown in line 1210, the probability of increased bookings is 15 percent and 5 percent probability for decreased bookings. This process ends in one of two ways. If you successfully generate 20 years of data, then you return. If you try to divide

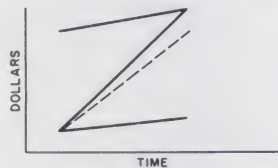


Fig. 1. The Z-chart defined.

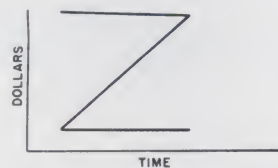


Fig. 2a. Z-chart for a no-growth company.



Fig. 2b. Z-chart for a 5 percent per month growth company.

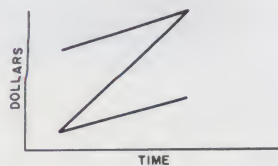


Fig. 2c. Z-chart for a planned withdrawal.

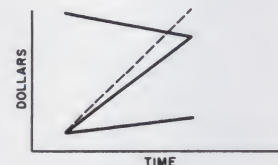


Fig. 2d. Z-chart for an unplanned withdrawal.



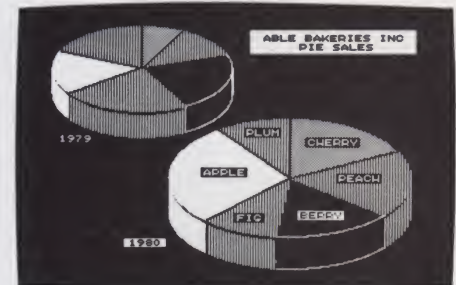
Fig. 3. Z-chart for a very good year.

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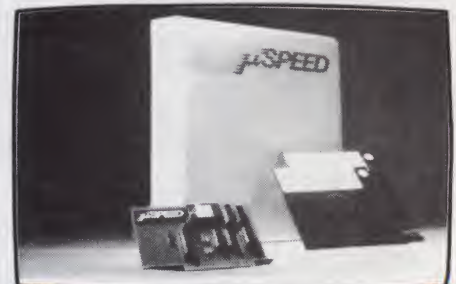
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by zero, then you call the error trapping and report that the company went bankrupt. During this process you will also be filling your data array, S(120,3).

**PLOT Z-CHART—2000.** This is the most difficult part of the program and the section that may deserve special attention, if you find that fooling around with arrays is a fun way to spend a couple of hours.

After verifying that a proper year has been selected (2000–2023), you back up 11 months and get the sum of the bookings during that period (2028–2038). The code from 2040 to 2070 is a major FOR-NEXT loop that sets the proper data from array S(X,3) and makes the necessary additions and subtractions to the array G(4,N).

To do the automatic scaling of the y-axis, the maximum value is determined in lines 2066 to 2068. After array G(4,N) has been filled, you call routine 2100, which does the automatic scaling of the y-axis based on the size of R in the array Z(R,C). This is done in lines 2106 to 2114. The assignment of the value for Z(R,C) is done in line 2140. Note that this is third-level nesting—for each unit of

the y-axis, for each month and for each of the four possible values in G(4,N).

Finally, the call is made to routine 2200, which does the printing of the Z-chart.

Figs. 3 and 4 show sample runs for the years 1974 and 1978 using the data from Table 2. The symbol B represents the YTD bookings, and P is the YTD plan. A lowercase m represents the monthly planned bookings,

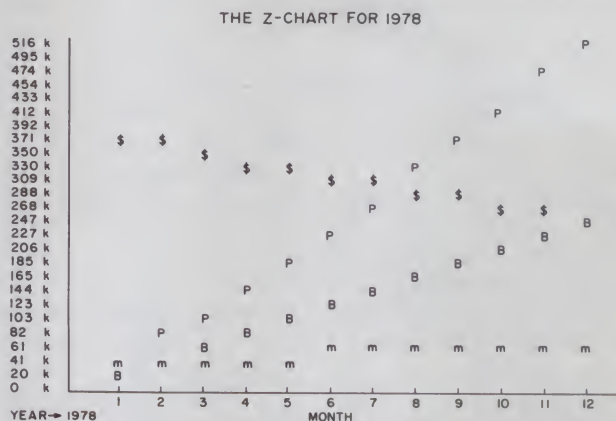


Fig. 4. Z-chart for a very bad year.

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Variable	Description
C1	Number of items in main menu
F	Used as scaling factor
F1	Flag used during display of main menu
G(4 12)	Temporary storage array
M	Local variable usually represents the month
M\$	Title of this program
Q	Output port for listing and displays
Q1	Selecting from the main menu
R1	Vertical resolution of y-axis of z-chart
S(240 3)	Array of time-plan-bookings
S\$	Subtitle for main menu
Y1	First year of data
Y2	Last year of data
Z(R1 12)	Array for plotting the z-chart
Z\$	File name of stored data

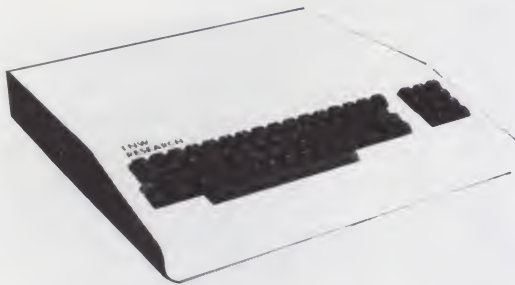
Table 1. Major variables used in ZCHART.BAS.

Entire data file PLAN/BOOKINGS												
Months -->	1	2	3	4	5	6	7	8	9	10	11	12
Year	1	2	3	4	5	6	7	8	9	10	11	12
71	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
72	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
73	16/16	17/17	17/17	18/18	19/19	20/20	21/21	22/22	23/23	24/24	26/26	27/27
74	28/28	30/30	31/31	33/33	34/34	36/36	38/38	40/40	42/42	44/44	46/46	48/48
75	48/48	46/46	44/44	42/42	40/40	38/38	36/36	34/34	33/33	31/31	30/30	28/28
76	27/27	26/26	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	17/17	16/16
77	16/32	16/32	16/32	16/32	16/32	16/32	16/32	16/32	16/32	16/32	16/32	16/32
78	32/16	34/18	36/18	38/19	40/20	42/20	44/21	46/21	48/22	50/22	52/23	54/24
79	28/25	28/30	25/28	32/30	33/35	31/29	35/33	34/39	36/25	35/20	35/25	30/25
80	32/48	44/56	70/52	38/28	50/34	78/51	43/41	56/5	87/87	41/41	54/54	82/82
81	46/47	45/48	45/49	42/42	47/54	45/51	46/48	47/46	49/54	51/48	51/48	51/50
82	52/52	50/56	54/61	56/59	58/58	61/61	66/71	67/68	73/71	83/94	89/92	93/93
83	71/75	71/77	73/81	82/88	80/81	84/88	86/92	80/85	80/83	81/78	77/84	74/84
84	83/88	91/97	100/113	97/96	101/100	113/110	110/111	115/116	124/133	117/122	132/139	133/147
85	123/129	119/121	129/144	141/137	136/130	155/152	154/160	166/178	159/161	166/162	165/162	169/167
86	157/157	176/187	189/205	198/211	220/213	225/235	255/289	261/276	270/304	264/284	261/298	284/277
87	231/220	248/254	239/273	267/268	258/245	279/310	292/296	304/299	304/318	286/307	275/309	263/284
88	29/30	32/34	36/36	38/40	41/44	39/39	43/46	45/50	50/53	50/57	45/50	50/60
89	40/50	46/51	45/46	50/51	51/49	52/52	55/61	53/61	56/62	57/57	60/60	67/76
90	64/64	67/75	75/80	85/94	85/91	92/89	93/104	102/98	110/118	110/117	118/119	115/124

Table 2. Twenty years of data.



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while \$ is the sum of the last 12 months of bookings. Since the absolute variation in the monthly plan is generally small compared to the maximum value of the y-axis, the slope of the bottom bar of the Z may not always be apparent from the chart. In this case, you should check the values used to plot the chart.

**SAVE DATA—3000.** This section saves the array S(X,3) in a data file named Z\$. First, it tests to see if the file exists (line 3010). If it does, it jumps to line 3020 and writes on top of existing data. If the file, Z\$, does not exist, then it is created in line 3012. The element S(X,1) of each record is a composite number, with the first two digits equal to the year and the remaining digits equal to the month. The element S(X,2) represents the planned bookings and the last element stands for the bookings.

**LIST TWENTY YEARS—4000.** A complete printout of all 20 years of data may be obtained by calling this routine. If you display the data on your terminal, Q=1, then a slight pause follows each year's display, using the WAIT=3 statement in line 4040.

**GET DATA FROM DISK—5000.** This is the inverse of section 3000. You may need to rewrite for your particular system.

**LIST ONE YEAR—6000.** You are first prompted for the year to be displayed; a linear search is then made to find the first month of the year. If the search fails, then you report it and ask if another year is wanted. When the year is found, you determine where to print the data by calling routine 8000 to assign the port number, Q. The heading is printed via routine 8100. The data for the year is printed by routine 6100, which also makes a calculation of the ratio of bookings to plan.

**CHANGE DATA—7000.** If you want to change the data for a year, this section is called. You again find the year under consideration, and then for 12 months display the current plan and bookings. This permits you to change the data. The array S(X,3) is changed during the process. If you use this section you should remember to save the data in the file Z\$.

Listing 2, ZLIST.BAS, is not a necessary part of the overall concept of Z-charting, but will prove useful as you generate your own data. The purpose of this program is to display a compact form of the 20 years of data contained in array S(N,3). Table 2

was printed using this program.

## Future

You can improve this program in several ways. If you select a large value for the y-axis resolution, you may find that the time required to fill the array is excessive and will want to find a way to speed up this process.

The bottom-bar problem mentioned earlier might be solved using some sort of a software logarithmic amplifier, but I have no ideal way to use and merge it into this program.

This program restricts the Z-chart plotting from January to December. You might want to expand the pro-

gram so that any month could be the starting month, since many companies start their fiscal year in July or September.

## Conclusion

A friend introduced me to Z-charting about nine months ago. It has taken me that long to begin to understand the concept and work out the program. Z-charting may help the businessman to get a little better view of his business. For the programmer, I hope you have gained some insight into another technique of making a scaled data array from the raw data of another array. ■

Listing 1. ZCHART.BAS.

```

0001 : ZCHART.BAS
0002 :
0003 : Gene Embry
0004 :
0010 ON ERROR GOTO 9990
0020 GOSUB 9800:: Program initialization
0099 :
0100 : Main
0101 :
0110 HOME
0112 LET DIGITS=0:RJUST=0
0120 PRINT TAB(W-LEN(M$)/2);M$:PRINT
0122 PRINT TAB(W-LEN(S$)/2);S$:PRINT
0124 PRINT "Y-axis resolution = ";R1;"units."
0128 PRINT
0130 FOR X=1 TO C1
0132 LET X$=STR$(X)+". "
0134 IF IMOD(X,2)=0 PRINT TAB(W);:F1=1
0136 PRINT X$;N$(X);
0138 IF F1=1 THEN PRINT:F1=0
0140 NEXT X
0170 SKIP 2
0180 INPUT "Make selection ",Q1
0190 IF Q1 < 1 THEN 100
0192 IF Q1 > C1 THEN 900
0194 GOSUB N(Q1)
0198 GOTO 100
0199 :
0900 : Done
0901 :
0910 PRINT
0920 PRINT "Bye!"
0990 END
0999 :
1000 : Make data
1001 :
1004 LET P=10:N=0:: We provide 'seed-money' of $10,000
1006 GOSUB 8000::Port
1010 FOR Y=Y1 TO Y2:: Years
1014 GOSUB 8100::Print headings
1020 FOR M=1 TO 12:: For 12 months
1022 GOSUB 1100::Get this month's Plan
1024 GOSUB 1200::Get this month's bookings
1026 GOSUB 1300::Fill up the array
1042 PRINT #Q,M,
1048 DIGITS= 1
1050 PRINT #Q,P,S,(S/P)*100:: Ratio of monthly bookings to Plan
1056 DIGITS= 0
1058 NEXT M
1060 DIGITS= 1
1062 LET V1=((S1-P1)/P1)*100::Ratio of annual bookings to Plan
1072 LET U$="==" : GOSUB 8200
1074 PRINT #Q,"Totals",P1,S1,V1
1076 DIGITS= 0
1078 LET P=S1/12:P1=0:S1=0
1080 PRINT #Q
1082 IF Y>Y2 THEN 1088
1084 IF Q=1 WAIT 5
1086 NEXT Y

```

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Listing continued.

```

1088 RJUST= 0:digits=0
1090 RETURN
1099 :
1100 : Get this month's Plan
1101 :
1110 LET L=INT(P*.94):H=INT(P*.14):: See text
1120 LET P=((H-L+1)*RND+L):: This month's Plan
1130 LET P=INT(P)
1140 LET P1=P1+P::Total of this years Planned bookins
1190 RETURN
1199 :
1200 : Get this month's Bookins
1201 :
1210 LET L=INT(P*.95):H=INT(1.15*P)
1220 LET S=((H-L+1)*RND+L):: This month's bookins
1230 LET S=INT(S)
1240 LET S1=S1+S::This year's bookins
1290 RETURN
1299 :
1300 : Fill array S(240,3)
1301 :
1310 LET N=N+1
1320 LET T$=STR$(Y)+STR$(M)
1322 LET T=VAL(T$)
1330 LET S(N,1)=T::Year and month
1332 LET S(N,2)=P::Plan for this month
1334 LET S(N,3)=S::Bookins for this month
1390 RETURN
1399 :
2000 : Plot the z-chart
2001 :
2008 INPUT "Plot the z-chart for which year ",T
2010 IF T < Y1+1 PRINT "Year must be greater than ":Y1: GOTO 2000
2012 GOSUB 8000::Port
2014 LET X$=STR$(T)+"1":Find Jan.'s data for year, T
2016 FOR Y = 1 TO 240 STEP 12
2018 LET T$=STR$(S(Y,1))
2020 IF X$=T$ THEN 2028:: We found it

```

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Listing continued.

```

2022 NEXT Y
2024 PRINT "Not on file":GOTO 2080::Failed to find the year
2028 PRINT "Workins"
2030 LET Y3=Y-11:H=0:S=0:N=0::Y3 holds the position of 11 months ago
2032 FOR X = 1 TO 12 :FOR Z = 2 TO 3:G(Z,X)=0:NEXT Z:NEXT X
2034 FOR X = Y3 TO Y-1
2036 LET S = S + S(X,3)::Sum of last 11 months bookings
2038 NEXT X
2040 FOR X = Y TO Y+11
2046 LET S = S + S(X,3)::Add this months' bookings
2048 LET N = N + 1::Move to next months pointer
2050 LET G(1,N) = S::Keeps sum of 12 months of bookings
2052 LET G(2,N) = G(2,N) + S(X,2)::YTD total of years plan
2054 IF N>1 THEN G(2,N) = G(2,N)+G(2,N-1)::YTD total of bookings
2056 LET G(3,N) = G(3,N) + S(X,3)::YTD bookings
2058 LET G(4,N) = S(X,2)::Plan for this month
2060 IF N>1 THEN G(3,N) = G(3,N)+G(3,N-1)
2062 LET S = S - S(Y3,3)::Subtract 11th month old bookings
2064 LET Y3 = Y3 + 1::move to next months bookings
2066 IF G(1,N) > H THEN H = G(1,N)::find the max. value
2067 IF G(2,N) > H THEN H = G(2,N)::find the max. value
2068 IF G(3,N) > H THEN H = G(3,N)::find the max. value
2070 NEXT X
2076 GOSUB 2100::Fill Z() with proper values
2078 GOSUB 2200::Print the array
2080 IF Q <> 1 THEN PRINT
2082 INPUT "Z-chart another year ",Q$
2086 IF Q$ = "Y" THEN G$="Y"
2088 IF Q$ = "Y" THEN 2000
2090 RETURN
2099 :
2100 : Fill up Z(R1,12) based on values in G(4,12)
2101 :
2105 PRINT "Fillins the array: ";
2106 LET F = H/R1::Scaling factor
2110 FOR R = 1 TO R1::For each unit on the y-axis
2112 PRINT R;
2114 LET Z1 = H-((R-1)*F):Z2 = (H-(R*F))::Determines upper & lower limits
2120 FOR C = 1 TO 12:: For each month
2122 LET Z(R,C) = 0::Assume a space will be printed.See line #2230
2130 FOR X = 1 TO 4:: Assign the type of information
2140 IF G(X,C) <= Z1 IF G(X,C) > Z2 THEN Z(R,C) = X
2150 NEXT X
2160 NEXT C
2170 NEXT R
2190 RETURN
2199 :
2200 : Print the array after fillins it
2201 :
2206 PRINT #Q
2208 PRINT #Q,TAB(30);"THE Z-CHART FOR ";T$="19"+STR$(T):PRINT #Q,T$
2209 PRINT #Q
2210 FOR R = 1 TO R1
2212 LET Z1=H-((R-1)*F)::Scaled value for vertical axis
2214 PRINT #Q,INT(Z1);
2218 PRINT #Q,TAB(06);"K 1 ";
2220 FOR C = 1 TO 12
2222 PRINT #Q,TAB(POS+4)::Position the printing head
2230 IF Z(R,C) = 0 THEN PRINT #Q," ";
2232 IF Z(R,C) = 1 THEN PRINT #Q,"$":Sum of last 12 months bookings
2234 IF Z(R,C) = 2 THEN PRINT #Q,"P":Sum of PLAN - YTD
2236 IF Z(R,C) = 3 THEN PRINT #Q,"B":Sum of bookings - YTD
2238 IF Z(R,C) = 4 THEN PRINT #Q,"m":Monthly plan for this year
2240 NEXT C
2242 PRINT #Q
2250 NEXT R
2280 PRINT #Q,"0":TAB(06);"K 1";
2282 FOR X = 1 TO 35:PRINT #Q,"_":NEXT X:PRINT #Q
2284 FOR X = 1 TO 12
2286 PRINT #Q,TAB(X*5+10);X;
2288 NEXT X:PRINT #Q
2289 PRINT #Q,"Year -> ";T$:TAB(38);"Month"
2290 RETURN
2299 :
3000 : Save data
3001 :
3010 IF FCHK Z$<>5 THEN 3020::If Z$ exists then skip to #3020
3012 CREATE #10,Z$,240,36:: Otherwise create the file Z$
3014 CLOSE #10
3020 OPEN #10,Z$
3022 RECNO #10=1
3030 FOR X=1 TO 240
3032 IF S(X,1)=0 THEN 3080
3040 WRITE #10,S(X,1),S(X,2),S(X,3)

```

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Listing continued.

```

3060 NEXT X
3080 CLOSE #10
3090 RETURN
3099 :
4000 : Print the complete array
4001 :
4010 GOSUB 8000::Which Port
4020 LET Y=1
4022 GOSUB 8100::Print headings
4030 GOSUB 6100::Print this years data
4040 IF Q = 1 THEN WAIT 3
4080 LET Y = Y + 12
4082 IF Y < 241 THEN 4022
4088 RJUST= 0:DIGITS=0
4090 RETURN
4099 :
5000 : Get data from disk
5001 :
5010 OPEN #10,Z$::IF can't open the line #9990 is called!!
5012 RECNO #10=1
5020 FOR X=1 TO 240
5030 READ #10,S(X,1),S(X,2),S(X,3)
5040 IF S(X,1)=0 THEN 5080
5050 NEXT X
5080 CLOSE #10
5090 RETURN
5099 :
6000 : Print a single years data
6001 :
6006 PRINT
6008 LET P1=0:S1=0:V1=0
6010 INPUT "Which years' data ",T
6011 LET X$=STR$(T)+"1"
6012 FOR Y = 1 TO 240 STEP 12
6014 LET T$=STR$(S(Y,1))
6016 IF X$=T$ THEN 6020
6018 NEXT Y
6019 PRINT "NOT ON FILE ":GOTO 6080
6020 IF Q1 = 7 THEN RETURN
6028 GOSUB 8000:: Port?
6030 GOSUB 8100::HEADING
6040 GOSUB 6100
6080 PRINT
6082 INPUT "Want another years' data ( Y or N ) ",Q$
6084 IF Q$ = "Y" THEN Q$="Y"
6086 IF Q$ = "Y" THEN 6000
6090 RETURN
6099 :
6100 : Scan and print one year
6101 :
6140 FOR X = Y TO Y+11
6142 PRINT #Q,X-Y+1,
6144 LET Z=S(X,3)/S(X,2)*100
6146 LET P1=P1+S(X,2):S1=S1+S(X,3)
6148 DIGITS= 1:RJUST = 3
6150 PRINT #Q,S(X,2),S(X,3),Z
6152 DIGITS= 0:RJUST = 0
6160 NEXT X
6170 LET U$="=:GOSUB 8200::underline$
6172 RJUST= 2:DIGITS=1
6174 PRINT #Q,"Totals",P1,S1,S1/P1*100
6180 DIGITS= 0:RJUST = 0
6190 RETURN
6199 :
7000 : Insert other data
7001 :
7010 GOSUB 6000::Get position in the array
7020 HOME
7022 PRINT "Year -> ";T
7024 PRINT "Month","Old Plan","Old Bookings"
7030 FOR X = Y TO Y+11
7032 PRINT X-Y+1,S(X,2),S(X,3),
7034 INPUT "New Plan, Bookings ",S(X,2),S(X,3)
7040 NEXT X
7080 INPUT "Want to change another years' data (Y/N) ",Q$
7082 IF Q$ = "Y" THEN 7000
7090 RETURN
7099 :
8000 : Port
8001 :
8010 INPUT "Which Port ",Q
8012 IF Q <> 3 THEN Q = 1
8020 IF Q=1 IF Q1<>1 THEN HOME
8090 RETURN

```

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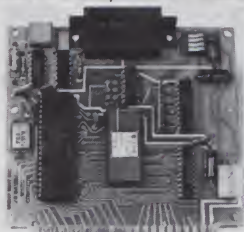
```

8099 :
8100 : Print Headings
8101 :
8110 IF Q=1 THEN HOME
8142 IF Y>240 THEN Y=1
8144 IF Y=0 THEN Y=1
8145 IF Q1=3 THEN T=Y:GOTO 8150::makins new data
8146 LET T$=STR$(S(Y,1))
8148 LET T=VAL(LEFT$(T$,2))
8150 PRINT #G, "YEAR" = "":T
8160 PRINT #G, "Plan", "Bookings", "Bookings/Plan"
8170 PRINT #G, "Month", "(K dollars)", "(K dollars)", "( % )"
8180 LET U$ = "—" : GOSUB 8200
8182 LET P1=0:S1=0:V1=0::Reset
8190 RETURN
8199 :
8200 : Print underline
8201 :
8220 FOR K=1 TO 30
8230 PRINT #G,U$;
8240 NEXT K
8280 PRINT #G
8290 RETURN
8299 :
8800 : Pgm. Variables
8801 :
8808 INPUT "Specify the y-axis resolution ",R1
8810 DIM S(240,3)::Data Array
8811 DIM Z(R1,12)::The z-chart array
8812 DIM G(4,12)::Temporary storage array
8814 LET W=30:LINE=0
8816 LET Y1=71:Y2=90:: From 1971 to 1990
8820 LET Z$="ZCHART.DAT"
8822 LET M$="Z-Charting a business"
8824 LET S$="Data from 19"+STR$(Y1)+" to 19"+STR$(Y2)
8830 FOR X = 1 TO 8
8832 READ N$(X),N(X)
8834 LET C1=C1+1:: Counter for items in menu

```

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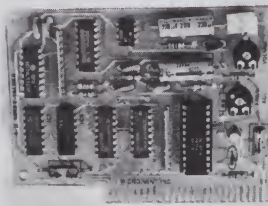


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Listing continued.

```

9896 NEXT X
9890 RETURN
9899 :
9900 : Data
9901 :
9910 DATA Plot the Z-Chart,2000
9912 DATA Save data on disk,3000
9920 DATA Make new data,1000
9922 DATA Print ALL the data,4000
9930 DATA Get data from disk,5000
9940 DATA Print a single years' data,6000
9950 DATA Insert one years' data,7000
9960 DATA Terminate,900
9981 :
9990 IF ERCODE = 8 PRINT "Company went bankrupt.":WAIT 5:GOTO 100
9992 PRINT "Error found in line ":ERLINE
9994 PRINT "Error code was ":ERCODE
9999 END

```

Listing 2. ZLIST.BAS.

```

0001 : ZLIST.BAS
0002 :
0003 : Gene Embry
0004 :
0010 ON ERROR GOTO 9990
0020 GOSUB 9800:: Program initialization
0099 :
0100 : Main
0101 :
0110 HOME
0112 LET DIGITS=0:RJUST=0
0120 PRINT TAB(W-LEN(M$)/2);M$:PRINT
0122 PRINT TAB(W-LEN(S$)/2);S$:PRINT
0128 PRINT

```

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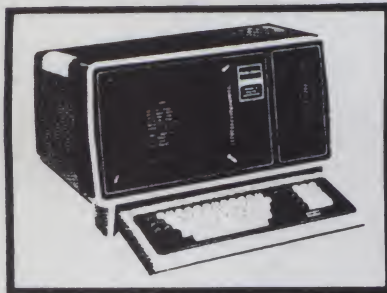
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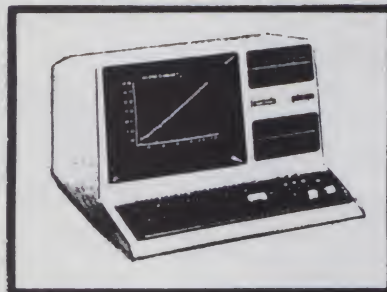
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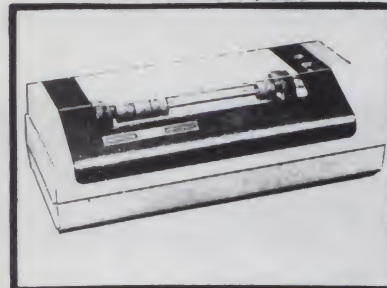
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Listing continued.

```

0130 GOSUB 8000::Port
0138 PRINT "Gettins data"
0140 GOSUB 5000::Get data
0150 GOSUB 8100::Print headins
0160 GOSUB 1000::Print the data
0190 GOSUB 8200::Print underline
0199 :
0900 : Done
0901 :
0990 END
0999 :
1000 : Print data compacted
1001 :
1010 FOR Y = 1 TO 240 STEP 12
1012 LET T$=STR$(S(Y,1))
1020 LET T$=LEFT$(T$,2)
1022 PRINT #Q,T$;
1030 FOR X = 1 TO 12
1032 LET A = S(Y+X-1,2):B=S(Y+X-1,3)
1034 LET X$=STR$(A)+"/"+STR$(B)
1036 PRINT #Q,TAB(TO*X);X$;
1038 NEXT X
1040 PRINT #Q
1080 NEXT Y
1090 RETURN
1099 :
5000 : Get data from disk
5001 :
5010 OPEN #10,Z$::If can't open the line #9990 is called!!
5012 RECNO #10=1
5020 FOR X=1 TO 240
5030 READ #10,S(X,1),S(X,2),S(X,3)
5040 IF S(X,1)=0 THEN 5080
5050 NEXT X
5080 CLOSE #10
5090 RETURN
5099 :
8000 : Port of Print
8001 :
8010 INPUT "Which port ",Q
8012 IF Q <> 3 THEN Q = 1
8090 RETURN
8099 :
8100 : Print Headins
8101 :
8110 IF Q=1 THEN HOME
8120 PRINT #Q,TAB(2*W);"Entire data file"
8122 PRINT #Q,TAB(2*W);"PLAN/BOOKINGS"
8124 PRINT #Q,TAB(TO);"Months -->"
8126 LET U$="=":GOSUB 8200::Print underline
8130 PRINT #Q,"Year";
8140 FOR X = 1 TO 12
8142 PRINT #Q,TAB(X*TO);X;
8148 NEXT X
8150 PRINT #Q
8160 GOSUB 8200::Print underline
8190 RETURN
8199 :
8200 : Print underline
8201 :
8220 FOR K=1 TO 58
8230 PRINT #Q,U$;
8240 NEXT K
8280 PRINT #Q
8290 RETURN
8299 :
9800 : Psm. Variables
9801 :
9810 DIM S(240,3)::Data Array
9812 LET M$="List z-chart data - compact form"
9814 LET W=30:LINE=0:TO=9
9816 LET A=0:B=0
9818 LET Y1=71:Y2=90:: From 1971 to 1990
9820 LET Z$="ZCHART.DAT"
9824 LET S$="Data from 19"+STR$(Y1)+" to 19"+STR$(Y2)
9890 RETURN
9899 :
9900 : Data
9901 :
9990 PRINT
9992 IF ERCODE = 8 PRINT "Company went bankrupt.":WAIT 5:GOTO 100
9994 PRINT "Error found in line ";ERLINE
9996 PRINT "Error code was ";ERCODE
9999 END

```



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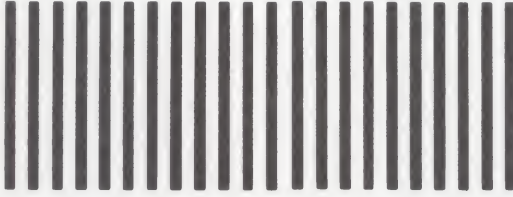
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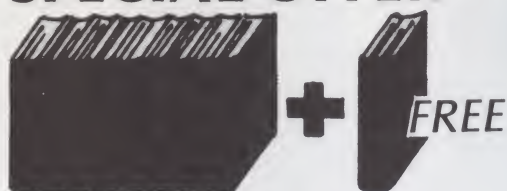
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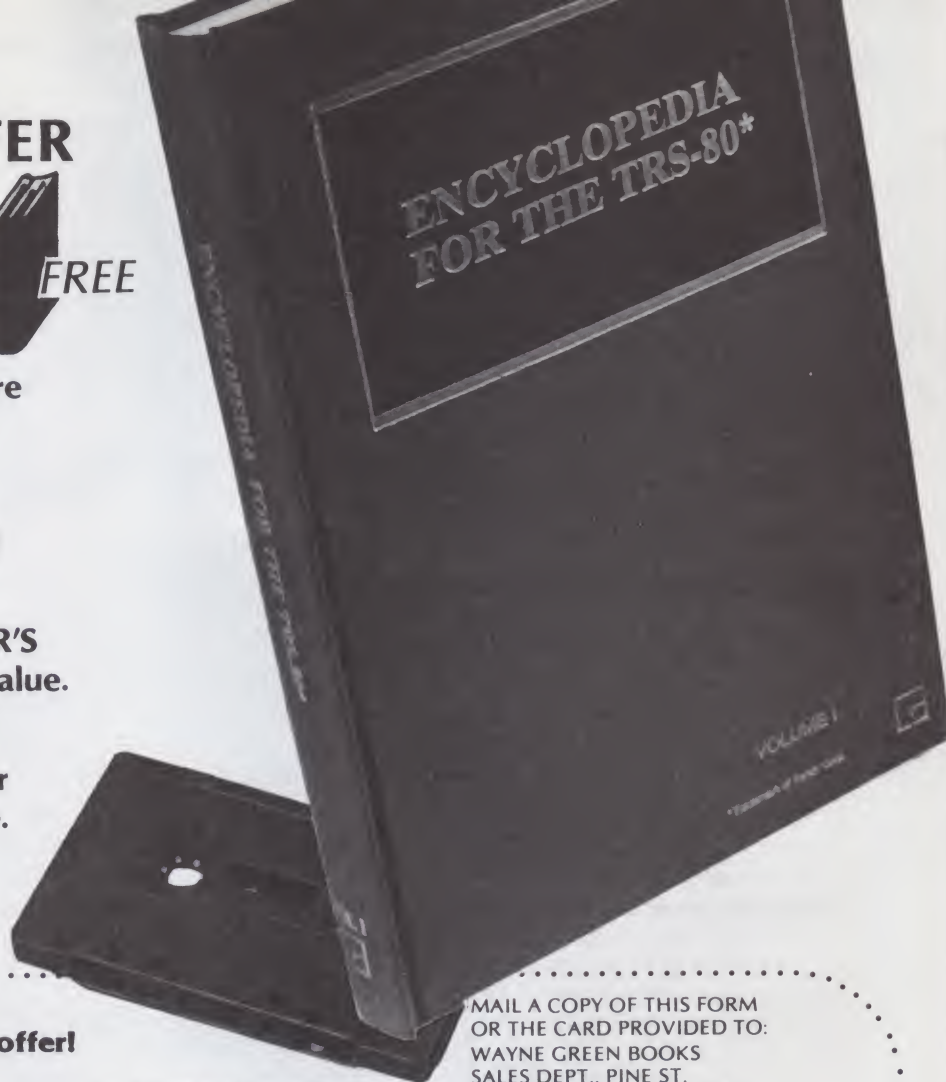
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# A Salty Saga

By Carle Collins

Life aboard a Navy aircraft carrier can be exciting and busy, but much of it is boring. There is very little to do during the hours not spent actually working or on watch: no corner pizza parlor where you can meet the gang for pizza and beer, no disco and no bowling alley. The average sailor contents himself with watching one-channel closed-circuit TV—if he

doesn't like the show presented, too bad. The ambitious men may work extra hours, but this soon becomes boring. Reading is about the only other form of entertainment available.

After a few weeks at sea, it is no wonder these guys blow off steam when they hit port.

As a field engineer on contract to the government, I have lived and worked with sailors, and have experienced the same problems. On a recent assignment, I tried a project aimed at helping relieve the boredom and increasing their knowledge. I had found that most of the sailors with whom I worked knew very little about integrated circuits, although they worked with them each day. They used computer-controlled systems, automated test stations and other sophisticated equipment, but with the cookbook repair manuals, they did not really have to understand the circuitry involved.

So I approached some of them with the idea of forming a class, where I would teach them about integrated circuits and bring them up-to-date on microprocessors and microcomputers. The response to my suggestion was overwhelming. Of the 30 people working in the shop to which I was assigned, 25 wanted to participate, including the shop supervisors.

I set out to find a suitable textbook which would give a good, detailed ex-

planation of the inner workings of a microprocessor and how it could be used in a system. My first stumbling block was getting books to review. Some readers may picture this as no task at all, since I only had to go to my nearest computer store and check over the books. Well, the nearest computer store happened to be about 900 miles away, across the open sea.

Since I was not a teacher at an established school, I had to buy any books I wanted to review. Needless to say, at the prices most vendors want for their publications, I didn't buy very many books just for review. Fortunately, I happened upon a review which credited the book's author with a good overview of the devices available and enough substance to make it suitable for my use. So I rushed an order to Sybex for a copy of Rodney Zaks' book, *Microprocessors, from Chips to Systems*.

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R7-R12	1.0k ohm resistor
R13-R18	220 ohm resistor
R19-R25	82 ohm resistor
C1	10 pF capacitor
XTAL	1.0 MHz crystal
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When I finally surfaced from my studies, I had a design. It would enable the student to build a simple microcomputer which he could program to perform simple tasks, and could eventually expand into a full-blown system if he wished. I based my decision on the availability of information on the particular device/system I selected, the price and availability of components and the existence of support hardware for future expansion. After evaluating all these points and the material I had available, I chose the system shown in the schematic diagram (see Fig. 1.)

### The System

The 6502/6530-002 combination provides a CPU with a monitor program which includes a keyboard routine, display routine and a Teletype routine to which the student can progress as he studies. We could have written our own monitor programs, but this approach was quicker and time was running out. We were headed overseas soon, to be faced with the added complications of foreign mail services. The 6530-002 was available through a vendor, and we had the KIM-1 to familiarize us with its characteristics. If I were to do it over, I would probably write the programs: I'm older and wiser now.

At the current price of random access memory, it was economical to use the 2114Ls. With this much memory, the students could write sophisticated programs in machine language, and even advance to video display as their budgets and ability permitted. The low-power version of the chip provided almost twice as much memory, for the same power, as the standard.

The seven-segment display used common-anode devices readily available from several of the surplus houses, and was modeled to take ad-

problem, try the Fleet Postal Service. Well, about the time I was ready to try sending a carrier seagull, Zaks' book arrived. It seemed to fit our needs, so I collected the money and "rushed" another order for the 25 books we needed for the course.

While we were discussing the course one day, one of the men asked if he could build a microcomputer during the course. My response was, "Why not?" I began searching for a suitable computer at an affordable price, because naturally everyone else wanted to build one too. We got information on available kits, and, after looking them over, we decided the students would save money and learn more by actually building and debugging their own units from scratch. That way, they would certainly get to know the system better than if they just plugged in some chips and hooked up a power supply. Since I was the engineer of the group, they asked me for a design suggestion.

Fortune smiled again. A colleague joined the ship with his Heathkit Trainer, and a sailor from another ship heard of our course and told me of his KIM-1, which he was just completing. This sailor also happened to

have all the issues of *Microcomputing* on board. I was ecstatic. I wrote to every company I could find that made components for microprocessors or computers, and, as might be expected, the responses ranged from nothing to fantastic.

RCA sent two 1802 chips and complete literature on the COSMAC series; Western Digital responded with several handfuls of support chips and stacks of literature; Synertek sent detailed manuals on the 6500 series; Zilog sent manuals on the Z-80; and Intel sent catalog data on their products. It was all useful in selecting a system.

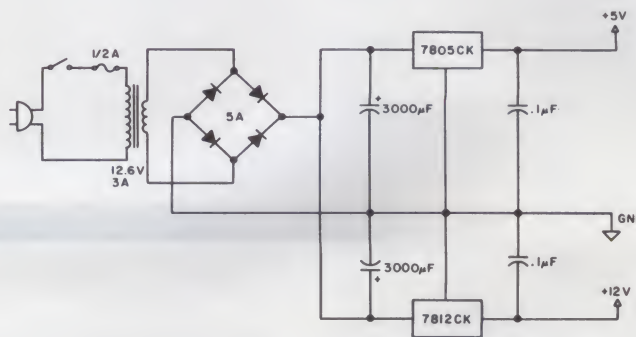


Fig. 3. Power supply.



vantage of the display routine inherent in the 6530-002.

The keyboard proved to be the most difficult problem. Hex keypads were available, at a price, and so were full 56-key/63-key keyboards, but the goal was an economical system which could be used and expanded at a later date. I finally found a 20-key calculator unit which might fit the bill. However, on its arrival I discovered it had one side of each switch connected to a common bus,

and I wanted to use the matrix coding with the keyboard routine in the ROM/IO. Maybe the unit could be modified. Students carefully removed the push-button unit from the printed circuit board that formed the contacts and bus interconnections. The common bus was cut and #30 wire added to form two groups of seven switches and one group of six. They used an outboard switch for the remaining required function. Fig. 2 shows the before-and-after configu-

rations of the keyboard unit. This portion of the work required some miniature soldering, but it could be done, with care, by a person with average skills.

The 6520 PIA was intended as an option to be added as the students progressed. When they considered the minor cost, they elected to purchase these chips with the other parts in order to have the necessary I/O ports for interface with the outside world. The experimenter never has

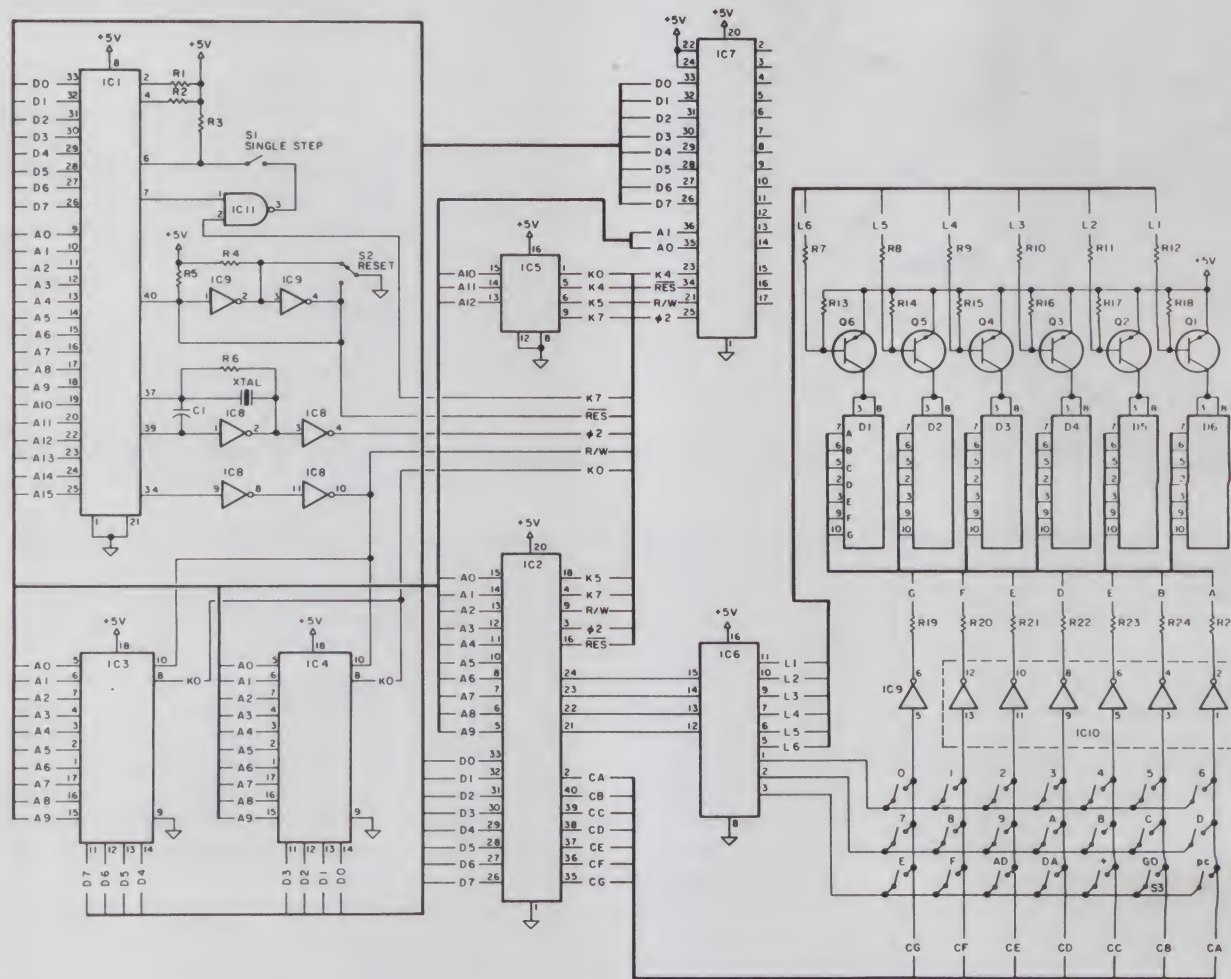


Fig. 1. System diagram.

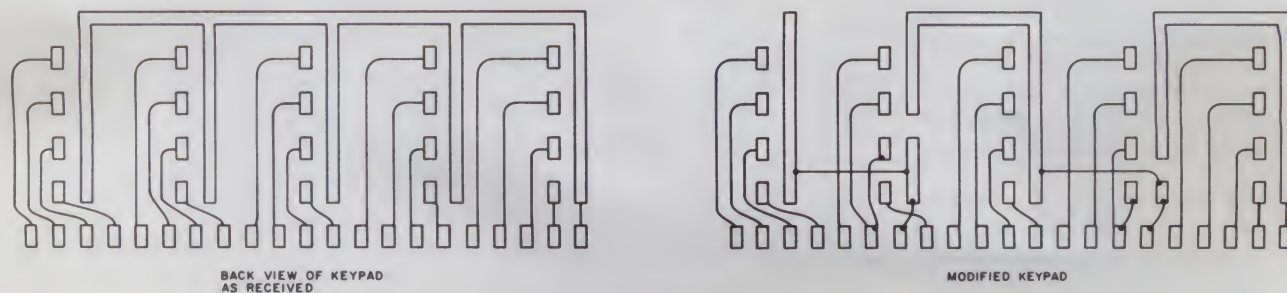
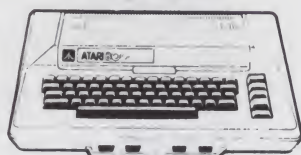


Fig. 2. Keypad modifications.





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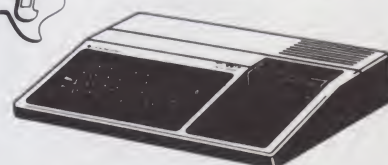
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enough I/O ports as he expands, so this seemed wise.

The 12 V, 3 A transformer in the power supply (Fig. 3) may seem like overkill in such a small project, but this trainer was designed with expansion in mind. The unit allows the experimenter considerable leeway in his system without having to immediately purchase another. The regulators supplied 5 V dc at 1.5 A and 12 V dc at 1.5 A. The 12 V supply was provided for activation of devices in the interface, since 5 V relays and lamps are not as prevalent as 12 V devices.

The construction method got almost as much consideration as the design, because I wanted the students to learn as much as possible while saving on the expense. I considered printed circuit techniques, but rejected them in view of the virtual requirement for double-sided boards and the number of holes to be drilled to accommodate the sockets or chips. Based on their job experience, the students felt that being able to quickly substitute chips during troubleshooting would be a great advantage, so sockets became necessary. All of them were familiar with wire-wrapping techniques, so we chose perforated boards and wire-wrap sockets as the best compromise.

About the time we were ready to begin construction, the first daisy-chain wire-wrapping tool appeared on the market, and we bought one to evaluate. One man went ahead and started his unit using conventional wire-wrap, but when the new tool arrived and he saw the first board wired with it, he dismantled his unit and started over. The advantages were immediately obvious.

The layout of sockets and packaging of the units were left to the student and varied with individual taste. Some placed everything on one board and mounted it in a chassis of individual design. Others simply used three modular pieces, with the CPU and support on one board, the keyboard and display on another and the power supply built as a separate unit for use with other projects. Each student made a design he felt would be most useful to him. The only thing common to each was the numbering of sockets and components, so that one wire list and schematic would be sufficient.

Two valuable lessons were learned during the construction. Wire-wrapping of the round leads found on discrete components resulted in inter-

mittents as the circuits were used and tested, because the test probe caused the wraps to loosen. The basic premise of wire-wrap is that the square corners of the posts dig into the wire and prevent loosening of the wrap. We solved that problem with the round leads by pre-tinning each one with solder, making the wrap and then sweating the joint with a soldering iron. This resulted in reliable joints which would withstand the probes of test equipment and yet did not detract from the overall efficiency of the wire-wrapping technique.

The other lesson was in the use of the polyethylene-insulated wire sent with the wire-wrap tool. Care must be taken to ensure that sufficient slack is left in each run of the wire to prevent chafing against posts or other wires. The insulation is very fragile and will quickly chafe and cause shorts, making troubleshooting very difficult.

The students bought their parts as a group to take advantage of quantity discounts, and I acted as their purchasing agent. This is one task I don't want again! Between the mail hang-ups and the vendors' stock problems, a three-to-four-week task required four months, and I was asked every day, "Have you heard anything from our parts?"

Sockets were the major problem and naturally the wiring had to wait until they were on hand. Most of the classroom training was complete before they all arrived and the work could begin. The students were thus more knowledgeable about the circuitry, but the value of having experiments to perform with the lectures was lost.

## Shipshape

In spite of all the problems that arose with this project, the overall results were gratifying. The students completed their computers, and some expanded to larger systems and even got into robotics and word-processing systems. They had learned enough to proceed on their own, and used me only as a sounding board for their ideas.

I recently received a call from one young man who left the Navy and got a job in industry. He told me that the training he got in that course directly enabled him to get his position with a large aerospace company. Results like this compensate for most of the headaches. ■



[illegible]

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# More for the XOR

By Allan D. Pratt

```
0001 'Simple Blinker Routine, to flash error message
0002 'Makes use of bit-flipping ability of XOR function
0003 'Written in Microsoft BASIC
0010 TEXT$= "Error! Hit spacebar to continue."
0020 STARS$=" ***** "
0030 BLANKS$=STRING$(LEN(TEXT$)," ")
0040 IF INP(1)<> 13 THEN GOTO 100
0050 IF I=0 THEN MIDDLE$=TEXT$ ELSE MIDDLE$=BLANKS$
0060 I=I XOR 1
0070 FOR J = 1 TO 300: NEXT J 'Delay Loop
0080 PRINT STARS$+MIDDLE$+STARS$;CHR$(13);
0090 GOTO 40
0100 PRINT:PRINT "Out of Loop"
```

Listing 1. Blinker routine.

```
0001 ' I is the value which will cycle thru the pattern.
0002 ' J is the mask with which I is XORd to change it.
0003 ' K is the mask with which J is XORd to flip it.
0010 INPUT I,J,K
0020 PRINT "J VALUE = ";J
0030 PRINT "K VALUE = ";K
0040 PRINT "STARTING VALUE OF I";I
0050 PRINT
0060 PRINT "CYCLE IS"
0070 FOR Z=1 TO 8
0080 J=J XOR K: I=I XOR J
0090 PRINT I;
0100 NEXT Z
0110 PRINT
0120 GOTO 10
```

Input values	Sample results
I=0, J=1, K=1	0,1,1,0,0,1,1,0
I=1, J=1, K=1	1,0,0,1,1,0,0,1
I=0, J=0, K=1	1,1,0,0,1,1,0,0
I=1, J=0, K=1	0,0,1,1,0,0,1,1

Listing 2. Double XOR loop.

In the November 1980 issue of *Microcomputing*, Alan Sclawy described an encryption scheme based on the use of the XOR function ("CP/M Encryption Prescription, p. 42). This same function can be used in some other interesting ways. For instance, you can use XOR to "flip a switch" back and forth, so that the program will first do one thing, then a second thing, then the first again, then the second again, and so on indefinitely.

XOR stands for Exclusive OR. It is one of the less-used Boolean operations. It is generally, if unclearly, explained as "either A or B but not both." For example:

A	B	A XOR B
1	1	0
1	0	1
0	1	1
0	0	0

In each case, if either A or B is 1, and the other is 0, the result is 1, but if A and B are the same—either both 1's or both 0's—the result is 0.

This doesn't seem particularly useful. But as Sclawy points out, there is another way to look at this operation. The effect of this operator is that if the B bit is 1, the A bit is flipped to its opposite state, while if the B bit is 0, the A bit is unchanged. We can consider the B bit—or, for that matter,

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the entire byte to the right of the XOR operator—as a selective mask. Now, consider what happens when you XOR an eight-bit byte with itself. Using 1 for an example, we have:

```
Bit 7 6 5 4 3 2 1 0
    0 0 1 1 0 0 0 1 (ASCII code for digit 1)
    0 0 1 1 0 0 0 1 (Again, same pattern of bits)
```

XOR 0 0 0 0 0 0 0 0 (Result is all zeros)

Now, if we XOR this result with our original number again, we come back to that original number, thus:

```
Bit 7 6 5 4 3 2 1 0
    0 0 0 0 0 0 0 0 (Result after first XOR)
    0 0 1 1 0 0 0 1 (Pattern for digit 1)
```

XOR 0 0 1 1 0 0 0 1 (Result is back to original value)

In BASIC, we could have

```
0010 X=X XOR 1
```

```
0020 PRINT X;
```

```
0030 GOTO 10
```

If we assume that X has not been assigned any previous value, and is therefore equal to zero, this will result in the printing of a continuous pattern of alternating 1's and 0's across the screen. This will work for any value up to 32767, in Microsoft BASIC at any rate. This value is one-half the maximum integer value the system can handle, so XORing it with itself will give all zeros. Any bigger number causes an overflow. If we XOR with 45, for example, instead of 1 in line 10, we will get a pattern of alternating 45s and 0's.

## Applications

This flip-flop operation can be put to good use in a variety of ways. For example, it could be used in a text processor to alternately print page numbers on the right and left sides of the page. Another use is shown in Listing 1, in which XOR is used as a blinker control. This short routine demonstrates the printing of an error message which flashes until the operator takes some appropriate action.

The error message TEXT\$ is printed on the screen, bracketed by asterisks. The MIDDLE\$ of the printed line is alternately replaced by BLANKS\$ or TEXT\$, depending on the value of I (0 or 1), with a delay loop between cycles. The process continues to cycle until you hit any key except CR. The CHR\$(13) instruction at the end of line 80 is a carriage return for the cursor. This, and the semicolon at the end, keeps the printing and blanking on the same line, rather than running it down the screen. Modifications of this general idea, by getting TEXT\$ from a string array of error messages, or changing

the operator's action and options as required, are fairly simple to invent.

This same idea can be used in computational programs. In some equations, for example, the sign of each term alternates. An instance of this is  $(1+x)^{-1} = 1-x+x^2-x^3+x^4-\dots$

You can create this alternating-sign effect easily with XOR. The brief program below demonstrates the effect of various simple combinations of numerical values which will cause these alternating patterns to appear:

```
10 INPUT A,B
20 FOR I=1 TO 8
30 A=A XOR B
40 PRINT A;
50 NEXT I
60 PRINT
70 GOTO 10
80 END
```

Some examples are:

A	B	Result
1	1	0,1,0,1,0...
0	1	1,0,1,0,1...
-1	-1	0,-1,0,-1,0...
0	-1	-1,0,-1,0,-1...
-1	-2	1,-1,1,-1,1...
1	-2	-1,1,-1,1,-1...

This XOR switching ability can be nested as well, to produce some more interesting patterns. You might, for example, want to execute some subroutine twice, then a second one twice, then the first one twice again, and so on. A pattern of alternating 0,0,1,1,... can be produced; or 1,1,0,0,...; or 1,0,0,1,...; or any of several other combinations.

Let I be the value which you want to cycle through the pattern. J is the mask against which I will be XORed. J is itself XORed against some constant, K, which will cause it to flip back and forth between two values. Since J flips between two values, I will vary over four different ones, though in some cases, there will be two values, which occur in pairs. The program in Listing 2 will let you experiment with various combinations of I, J and K.

One of particular interest is I=3, J=1 and K=2. This will result in 0,1,2,3,0,1,2,3 giving a four-beat cycle. This would allow the selection of four different subroutines in a recurring pattern.

It is possible to extend this notion further, with yet another nested XOR, but beyond two levels, keeping track of what is going on will become too complicated to be worth the trouble. To control over four options it is probably better to use a more conventional technique, such as a counter or a FOR-NEXT loop. ■



### TTL

7400	2/.85	7490	.85
7402	2/.85	7493	.85
7404	2/.85	74100	2.25
7406	2/1.19	74109	2/1.19
7407	2/1.19	74121	.69
7408	2/.89	74123	.99
7410	2/.85	74150	1.95
7414	.99	74154	1.95
7417	2/1.10	74157	1.19
7420	2/.85	74161	1.19
7447	1.19	74164	1.59
7474	.69	74174	1.49
7475	.79	74175	1.49
7476	.69	74192	1.19
7485	1.19	74193	1.19
7486	2/1.19	74367	.99
7489	2.99	74393	1.95

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3/4 Watt @ 70°C  
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Linear Taper  
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1K, 5K, 10K, 50K,  
100K, 500K, 1Meg  
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### NSN 373

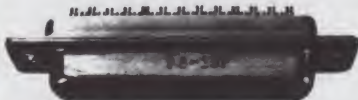
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4006	1.49	4046	1.95
4009	.79	4047	2.75
4010	.79	4049	.79
4011	.55	4050	.89
4013	.79	4051	1.59
4016	.79	4056	.69
4017	1.39	4059	.75
4018	1.39	4070	.69
4020	1.39	4071	.69
4023	.49	4081	.59
4024	1.19	4093	1.19
4027	.79	4511	1.95

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DB25S	D-Subminiature Socket	4.95
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UG89/U	BNC Jack	3.95
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PL258	UHF Adapter	1.95
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UG260/U	BNC Plug	2.39
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LM305H	1.39	LM7812T	1.75
LM307N	.75	LM7815T	1.75
LM308N	1.19	LM380N	1.49
LM309K	2.25	LM384N	2.49
LM310N	2.69	LM555N	.69
LM311N	1.49	LM556N	1.49
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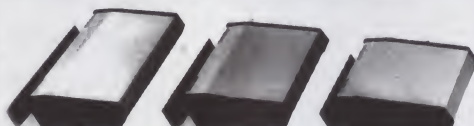
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74LS10	.55	74LS154	1.95
74LS14	1.09	74LS157	1.19
74LS30	.55	74LS161	1.29
74LS32	.69	74LS174	1.19
74LS38	.69	74LS175	1.19
74LS42	1.29	74LS192	1.49
74LS47	1.29	74LS193	1.49
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1N4733	2/.69	2N4403	2/.79
1N4734	2/.69	2N5129	2/.69
1N4735	2/.69	2N5139	2/.69
1N4742	2/.69	2N5210	2/.79
1N4744	2/.69	2N5951	2/1.29

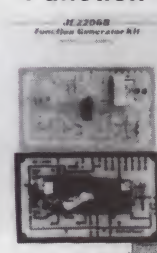
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2.2mfd @25V	2/1.09	22mfd @50V	2/.79
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# A Spacesaver For the Bytesaver II

By George S. Losey

The Cromemco Bytesaver II is a handy S-100 memory board, but it does have limitations. On the positive side it can house and program up to 8K bytes of programmable read-only memory (PROM) and reside in any of eight memory banks. It can be selected for DMA (direct memory access) even when it resides in an inactive bank and is overlapped by another board in an active bank (as long as the other board also has DMA override features).

Unfortunately, the Bytesaver is also a memory hog. My Z-2 uses only 1K or 2K of PROM, but when those addresses are active, the entire 8K is active. The Bytesaver will drive the data bus high when any of the empty PROM sockets are addressed. If other memory occupies the same address, a bus conflict is created with disastrous results.

I was able to live with this minor inconvenience until I installed a Dataspeed disk controller. It has a PROM that demands exclusive use of 1K of memory at F000 (hex). The Cromemco monitor demands 1K at E000. Placing the Bytesaver in the highest page of memory to keep the

monitor happy made it impossible to use the disk controller.

Since it does me little good to have a resident monitor that lives in an inactive memory bank, I set out to modify the board. The modification had to fulfill three goals. First, it had to be nondestructive. I hate cutting

entire 8K of PROM space.

Finally, I demanded that it be simple and cheap, since I spend too much time on this stuff *anyway*.

The modification I made costs about \$1, takes 20 minutes to complete and fulfills all of my goals. It uses an SPST switch (switch 8,

---

Since it does me little good  
to have a resident monitor  
that lives in an inactive memory bank,  
I set out to modify the board.

---

foils and then having to solder them back after discovering my supposed improvements only resulted in messing up a perfectly good board.

Second, it had to allow the Bytesaver to be switch-selected to occupy either an entire 8K page of memory or restrict itself to the lowest 1K region of the page. In this manner, it could house my 1K monitor and not interfere with the disk controller. I could then devote the remaining 6K of space to RAM by using a Thinker-toy Memory Master 16K board selected to have a 1K window for both the monitor and for the disk controller. Or, when desired, I could pop the top off the computer and select the

ADDR/CONTROL bank) and two 74LS00 gates (IC1). In its simplest form it adds one restriction: The DMA OVERRIDE and DMA IN/OUT switches can't both be on when the special 1K ONLY option is selected. This causes a few problems and is discussed fully below.

Before going any further, you should correct an error in the July 1, 1979, Bytesaver II manual. If your board is like mine (revision C), your manual may well be wrong. The person who drew the schematic, revision 3 (p. 26 of the manual), was right on target; but whoever drew the figures in part II was confused. The DMA OVERRIDE and DMA IN/OUT

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Address correspondence to George S. Losey, University of Hawaii at Manoa, PO Box 1346, Coconut Island, Kaneohe, HI 96744.



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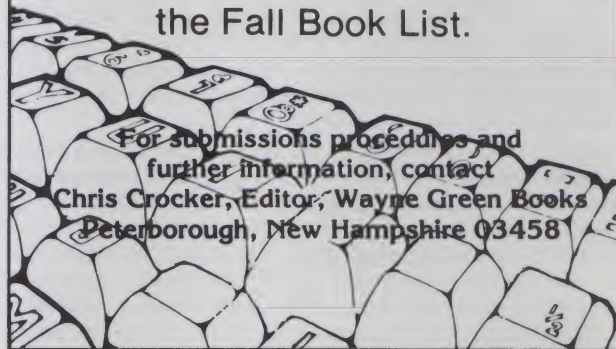


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switches in the ADDR/CONTROL bank are reversed in figures 2, 3, 4 and 10. Switch No. 2 is the DMA IN/OUT and switch No. 3 is the DMA OVERRIDE. DMA does not work very well unless you change these figures.

### Keep It Low

The key to the modification is to keep the board enable signal from going high unless bus address signals, A10, A11 and A12 are all low; i.e., unless the lowest 1K PROM is addressed. Board enable is a wired AND of several lines. If one of the several inverter gates is kept low, board enable remains low.

The simplest approach that I could find is to keep the NAND output at pin 3 of IC 1 high. I used the unused switch (no. 8) in the ADDR/CONTROL switch bank (renamed as the 1K ONLY switch), one of the unused NAND gates in IC 1, and two OR gates in a 74LS32 that was added to the board. In the circuit shown in Fig. 1, the OR gates decode A10, A11 and A12 and drive the extra NAND. The NAND, when the 1K ONLY switch is closed (on), holds input pin 1 on IC 1 low when any of the three address lines are high. This causes pin 3 of IC 1 to remain high and board enable to remain low. When the 1K ONLY switch is open (off), the entire 8K board is addressed.

Note that when the 1K ONLY switch is closed, if both the DMA IN/OUT and DMA OVERRIDE switches are closed, the 74LS04 inverter is placed in a wired AND with the 74LS00 gate that has been added. This is a no-no with totem pole outputs, so this board should never be configured with all switches closed. However, the only time that both DMA switches are closed is when the board is residing in an inactive memory bank but is to be selected for DMA addressing during a read. One would rarely want to perform a DMA read from a PROM. If this was needed, the 1K ONLY switch might as well be open at any rate since the board is not selected.

I decided that having a potentially dangerous switch combination was less evil than cutting foils to modify the circuit. If you decide that you don't mind cutting foils, a solution is at hand that demands only three additional resistors (Fig. 2). First, a 74LS33 must be used in place of the 74LS32 used above. The two extra OR gates are used as buffers in order

to implement a wired AND. Pull-up resistors must be added to the OR gates used to decode A10, A11 and A12. The foil connection between pin 4 of RN2 and pin 1 of IC 1 is severed. Pin 4 of RN2 is led to both inputs of one of the extra OR gates, and the output from the 1K ONLY switch is led to both inputs of the other extra OR gate. The outputs of both OR gates are placed in common as a wired AND with a 1k, 1/4 watt pull-up resistor and connected to pin 1 of IC 1. The wired AND is now implemented and you can fiddle with the switches to your heart's content.

Construction of the modification can be done without cutting foils. A 1/2-inch x 3/16-inch chip of plexiglass is epoxied to the component side of the board with a 14-pin socket epoxied to it so that the soldering pins do not contact the board. Run a few lengths of wire-wrap wire through convenient holes on the board and solder in place. Be careful not to damage the insulation on these wires where they lead through these holes. The holes are plated through connections, and shorts could lead to very uninteresting results. The modi-

fied board has the same vertical clearance as the original board and can fit into a tightly packed S-100 bus.

If you have some time on your hands and desire a fancier solution, a more complex circuit could put any combination of the eight PROMS out of commission. An additional 74LS42 (1 of 8 decoder), eight 74LS36 (exclusive OR gates) and a bank of eight switches would be required. The A, B and C inputs of the 74LS42 are connected to the A10, A11 and A12 bus inputs. The D input of the 74LS42 must be tied to ground. The switches and exclusive OR gates are then connected, similar to the existing A13, A14 and A15 logic. The exclusive ORs are then all connected with a 1k pull-up resistor in a wired AND. The wired AND output is then used in place of the OR output in the previous solution. Note that you cannot use the existing 74LS42 for this purpose. The D input for this chip is generated by board enable—your board would never be enabled.

I have used my modified board at both 2 and 4 MHz speeds without any problem. This spacesaver for the Bytesaver II works well. ■

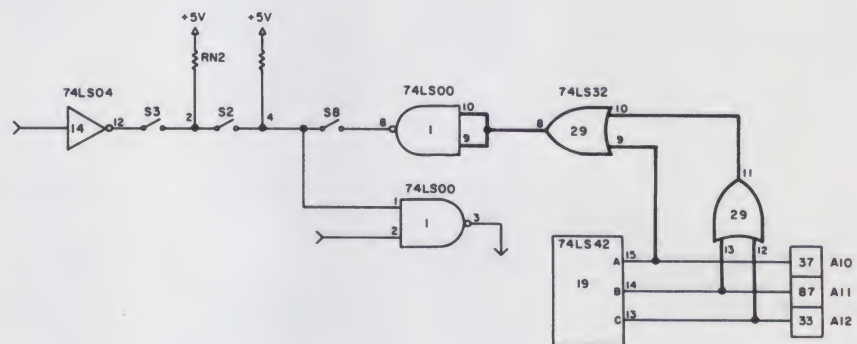


Fig. 1. Schematic for Bytesaver II modification. ICs 1, 14 and 19 correspond to the factory schematic. Bold lines indicate the added IC 29 and its connections. With this circuit, if switch 8 is closed, the DMA IN/OUT and DMA OVERRIDE switches cannot both be closed at the same time.

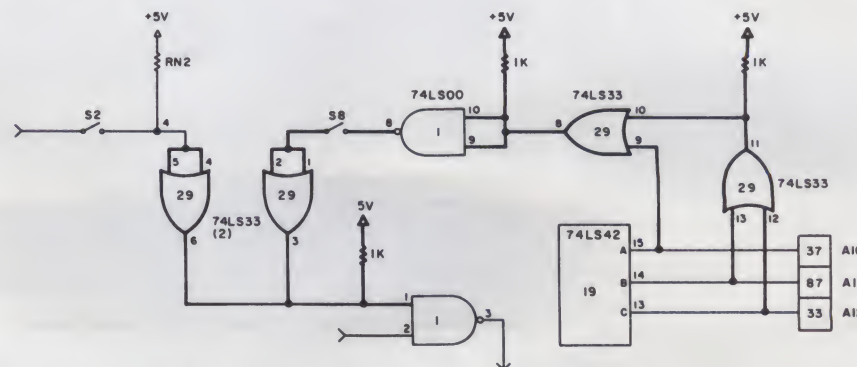


Fig. 2. Schematic for alternate Bytesaver II modification. This circuit lacks the switch closure restrictions of the circuit in Fig. 1. The factory-printed connection between pin 4 of RN2 has been severed. Bold lines indicate added parts (IC 29 and three 1/4 W resistors) and their connections.



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## The Philadelphia Area Computer Society

The Philadelphia Area Computer Society meets in the LaSalle College Science Building at the corner of 20th and Olney Ave. The society has many user's groups including Apple, Atari, CP/M, Ohio Scientific, Pascal, PET, and TRS-80. Membership applications should be sent to The Data Bus, PACS, Box 1954, Philadelphia, PA 19105. 215-925-5264.

## Northwest Computer Society

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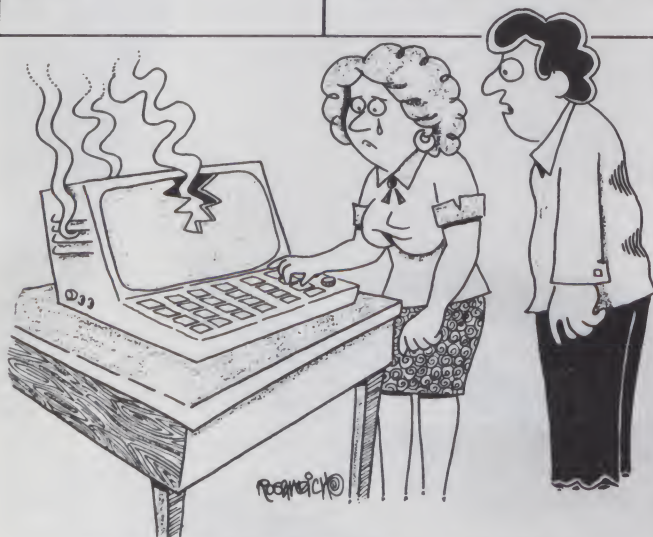
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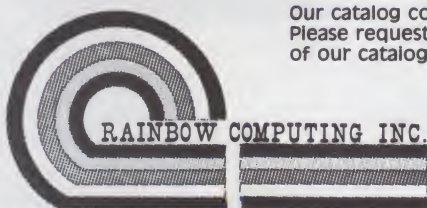
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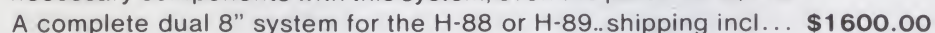


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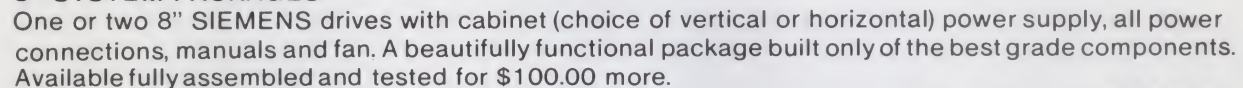
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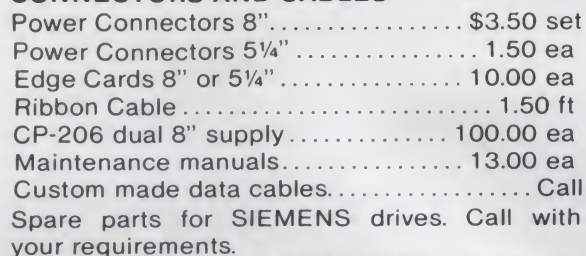


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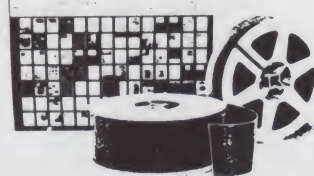
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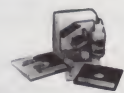
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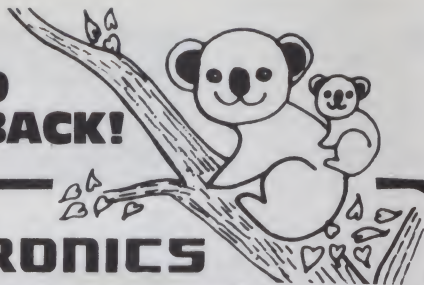
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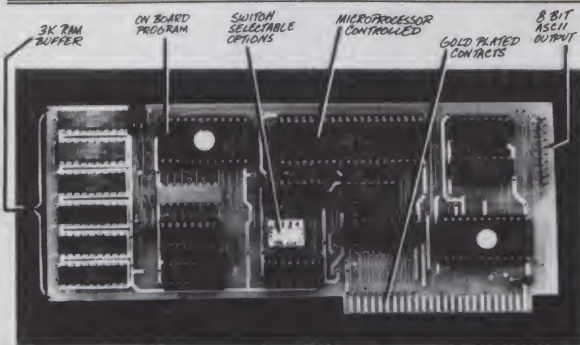
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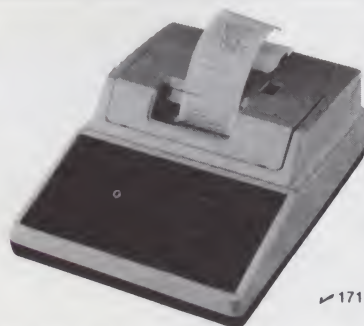
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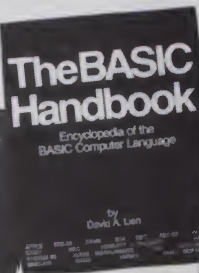
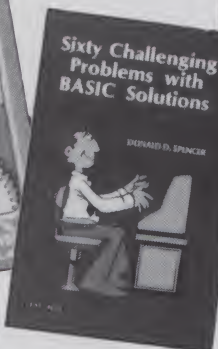
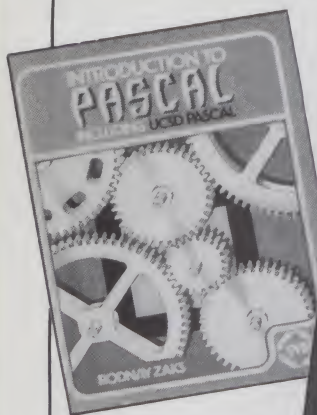
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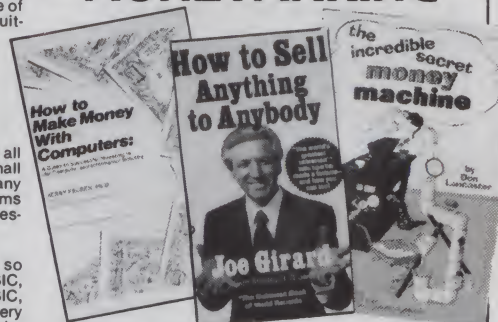
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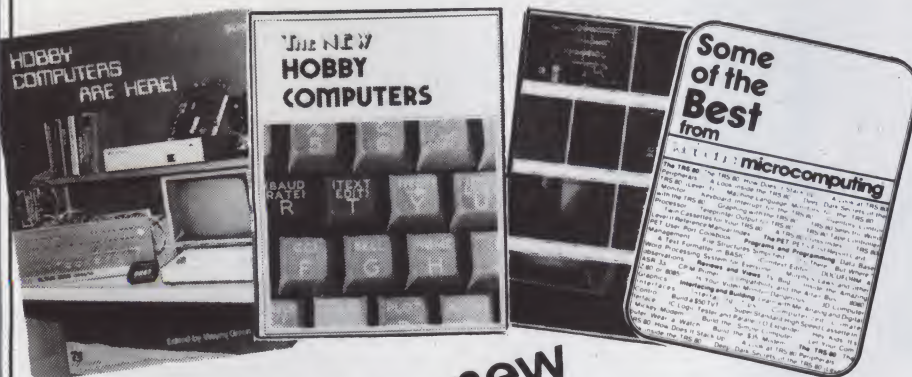
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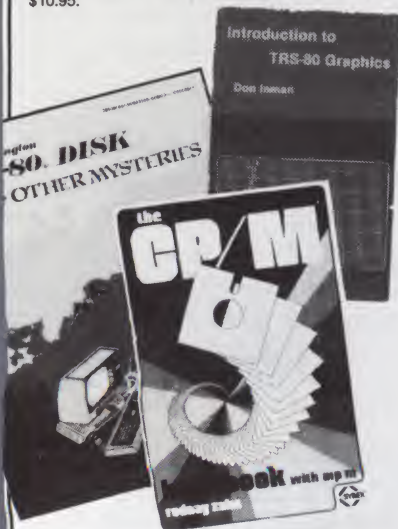
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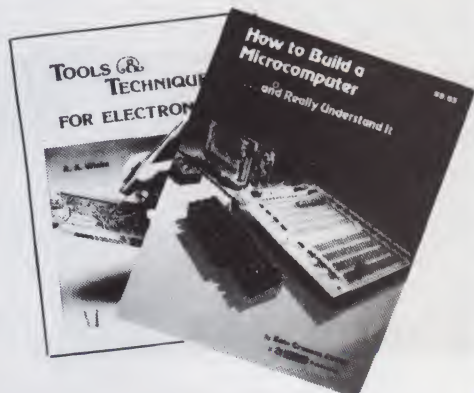


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74249N	LM340T-15	85	CD4090	95	2114L 450ms	2.37	N823182	8.75	55-position	95
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74253N	LM340T-12	85	CD4092	95	2114L 450ms	2.37	N823184	8.75	57-position	95
74255N	LM340T-15	85	CD4093	95	2114L 300ms	3.25	N823185	8.75	58-position	95
74257N	LM340T-24	85	CD4094	95	2114L 450ms	2.37	N823186	8.75	59-position	95
74259N	LM340T-12	85	CD4095	95	2114L 300ms	3.25	N823187	8.75	60-position	95
74261N	LM340T-15	85	CD4096	95	2114L 450ms	2.37	N823188	8.75	61-position	95
74263N	LM340T-24	85	CD4097	95	2114L 300ms	3.25	N823189	8.75	62-position	95
74265N	LM340T-12	85	CD4098	95	2114L 450ms	2.37	N823190	8.75	63-position	95
74267N	LM340T-15	85	CD4099	95	2114L 300ms	3.25	N823191	8.75	64-position	95
74269N	LM340T-24	85	CD4100	95	2114L 450ms	2.37	N823192	8.75	65-position	95

### Phone orders only (800) 538-8196

UART/FIFO			DE95	1.95
AVS-1013	5.50		DA15P	2.10
AVS-1014	7.50		DA15S	3.10
3341	6.95		Complete Set	9.50
			Staple with Kit	26.95
FROM			Aside Check Kit	17.95
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99 2708	3.95			
65 2716T	5.95			
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2102A-2	1.65			
N8223	2.95			
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N823126	5.75			
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25 N823131	4.95			
37 N823136	8.75			
38 N823137	8.75			
40 N823138	8.75			
42 N823139	8.75			
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CONNECTIONS				
85 8748	55.00			
84 44 100 pin edge	2.75			
100 96 pin edge	2.75			
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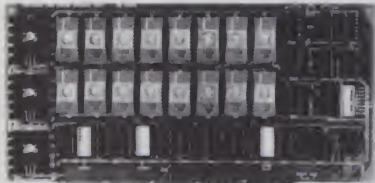


# DIGITAL RESEARCH COMPUTERS

(214) 271-3538

## 32K S-100 EPROM CARD

**NEW!**



**\$79.95**  
KIT

USES 2716's

Blank PC Board - \$34

ASSEMBLED & TESTED  
ADD \$30

SPECIAL: 2716 EPROM's (450 NS) Are \$9.95 Ea. With Above Kit.

### KIT FEATURES:

1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

## 16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

**\$169<sup>95</sup>**  
KIT

FOR 4MHZ  
ADD \$10



### KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-\$33

LOW PROFILE SOCKET SET-\$12

SUPPORT IC'S & CAPS-\$19.95

ASSEMBLED & TESTED-ADD \$35

**OUR #1 SELLING  
RAM BOARD!**

NEW!

**STEREO!**

## S-100 SOUND COMPUTER BOARD

NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

### KIT FEATURES:

- \* TWO GI SOUND COMPUTER IC'S.
- \* FOUR PARALLEL I/O PORTS ON BOARD.
- \* USES ON BOARD AUDIO AMPS OR YOUR STEREO.
- \* ON BOARD PROTO TYPING AREA.
- \* ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- \* PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
- \* EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
- \* USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

### SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M™ compatible diskette or 2708 or 2716. Diskette - \$24.95 - 2708 - \$19.95 - 2716 - \$29.95. Diskette includes the source. EPROM'S are ORG at E000H. (Diskette is 8 Inch Soft Secored)

### 4K STATIC RAM

National Semi. MM5257. Arranged 4K x 1. +5V, 18 PIN DIP. A Lower Power, Plug in Replacement for TMS 4044. 450 NS. Several Boards on the Market Will Accept These Rams. SUPER SURPLUS PURCHASE! PRIME NEW UNITS!

8 FOR \$16 32 FOR \$59.95

**Digital Research Computers**  
(OF TEXAS)

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## 32K SS-50 RAM

**\$299<sup>00</sup>** KIT

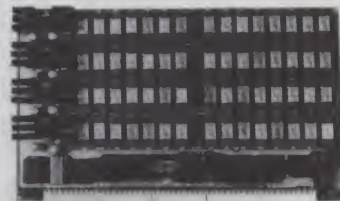
For 2MHZ  
Add \$10

Blank PC Board  
\$50

For SWTPC  
6800 - 6809 Buss

Support IC's  
and Caps  
\$19.95  
Complete Socket Set  
\$21.00

Fully Assembled,  
Tested, Burned In  
Add \$30



At Last! An affordable 32K Static RAM with full 6809 Capability.

### FEATURES:

1. Uses proven low power 2114 Static RAMS.
2. Supports SS50C - EXTENDED ADDRESSING.
3. All parts and sockets included.
4. Dip Switch address select as a 32K block.
5. Extended addressing can be disabled.
6. Works with all existing 6800 SS50 systems.
7. Fully bypassed. PC Board is double sided, plated thru, with silk screen.

## 16K STATIC RAM SS-50 BUSS

PRICE CUT!

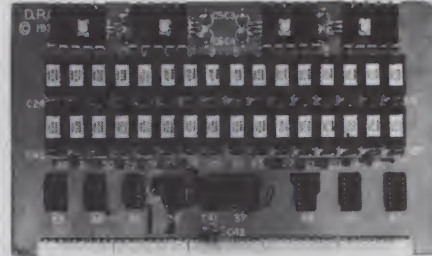
**\$159** KIT

FULLY STATIC!

FOR 2MHZ  
ADD \$10

FOR SWTPC  
6800 BUSS!

ASSEMBLED AND  
TESTED - \$35



### KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

BLANK PC BOARD-\$35

COMPLETE SOCKET SET-\$12

SUPPORT IC'S AND CAPS-\$19.95

## SPECIAL PURCHASE!

## UART SALE!

TR1602B - SAME AS TMS6011,  
AY5-1013, ETC. 40 PIN DIP

**TR1602B**

**\$2<sup>95</sup>** EACH

**4 For \$10<sup>00</sup>**

### CRT CONTROLLER CHIP

SMC #CRT 5037. PROGRAMMABLE FOR 80 x 24, ETC. VERY RARE SURPLUS FIND. WITH PIN OUT. \$12.95 EACH.

### NEW! G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control. 16 bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. \$11.95 PRICE CUT!

SPECIAL OFFER: \$14.95 each Add \$3 for 60 page Data Manual.

TERMS: Add \$2.00 postage. We pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa and MasterCard. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50, add 85¢ for insurance.

ALL SALES ARE MADE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.

\*TRADEMARK OF DIGITAL RESEARCH.

WE ARE NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

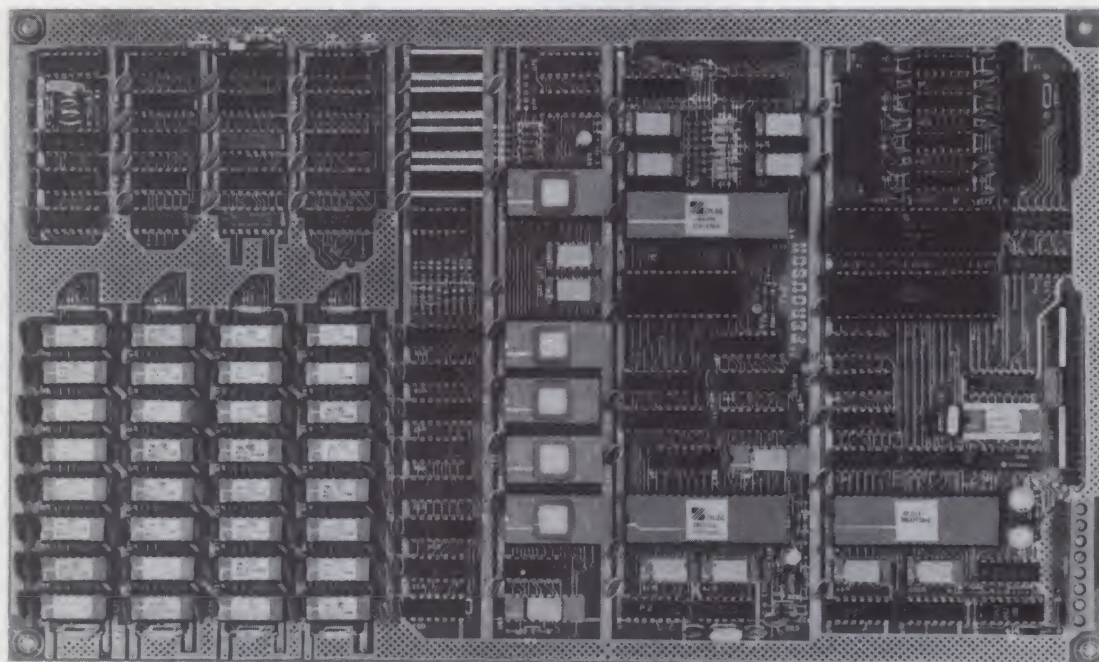


# NEW!

## "THE BIG BOARD" OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC SINGLE BOARD COMPUTER KIT! Z-80 CPU! 64K RAM!

# NEW!

PARTIALLY ASSEMBLED KITS  
For All Sockets Installed  
And Soldered Add \$50.



**THE FERGUSON PROJECT:** Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M\*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

**\$649<sup>00</sup>** \*\*

(64K KIT  
BASIC I/O)

SIZE: 8 1/2 x 13 3/4 IN.  
SAME AS AN 8 IN. DRIVE.  
REQUIRES: +5V @ 3 AMPS  
+ - 12V @ .5 AMPS.

### FULLY SOCKETED!

### FEATURES: (Remember, all this on one board!)

#### 64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

#### Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software.

#### SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: \$85.

#### BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

#### 24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

#### FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M\* 2.2.

#### TWO PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: \$29.95

#### REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: \$14.95

#### SYSTEM COMPARISON

64K RAM KIT	\$370.00
80 x 24 Video Kit	365.00
Floppy Disk Controller Kit	235.00
Z-80 CPU Kit	185.95
SER & PAR. I/O	129.95
S-100 Mother Board	45.00
SUB TOTAL	\$1330.90

Talk about bangs per buck! The prices shown for S100 kits were taken from the July 1980 BYTE. This will give some basis for comparison between the Big Board and a similar system implementation on the S100 Buss.

#### CP/M\* 2.2 FOR BIG BOARD

The popular CP/M\* D.O.S. modified by MICRONIX SYSTEMS to run on Big Board is available for \$150.00.

#### PC BOARD

Blank PC Board with Rom Set and Full Documentation.  
\$199.00

#### PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M\*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.  
Z-80 is a Trademark of Zilog.

## Digital Research Computers

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**TERMS:** Shipments will be made approximately 3 to 6 weeks after we receive your order. VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a \$75 deposit. Balance UPS COD. Add \$3.00 shipping

USA AND CANADA ONLY

\*TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE ORIGINATORS OF CPM SOFTWARE  
\*\*1 TO 4 PIECE DOMESTIC USA PRICE.



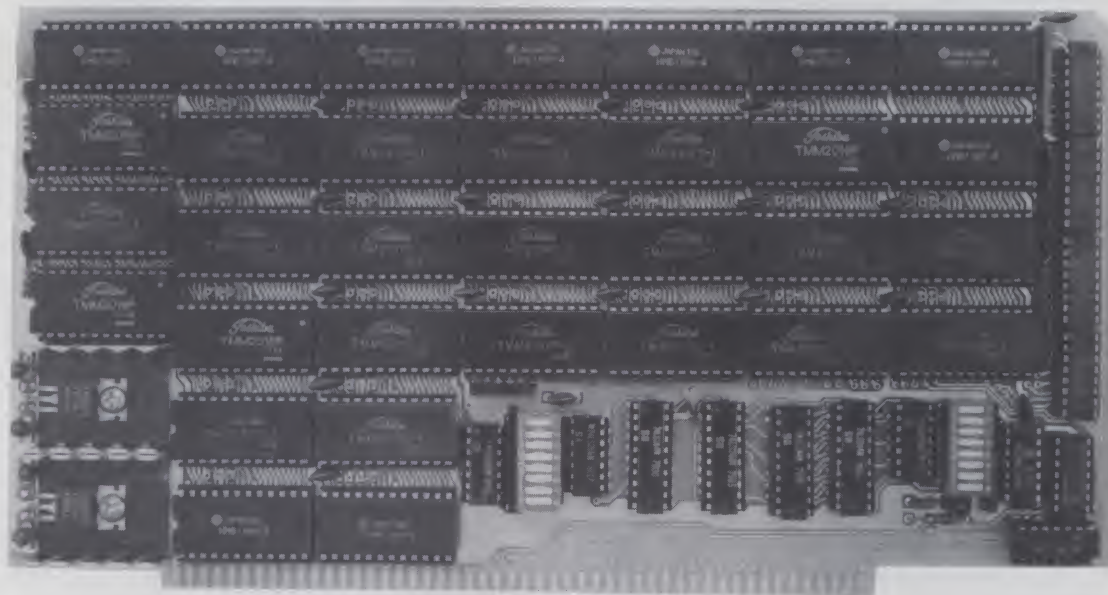
# 64K S100 STATIC RAM

**NEW!**

**\$499<sup>00</sup>**  
KIT

**NEW!**

LOW  
POWER!



RAM  
OR  
EPROM!

BLANK PC BOARD  
WITH DOCUMENTATION  
\$55

SUPPORT ICs + CAPS - \$17.50  
FULL SOCKET SET - \$14.50

ASSEMBLED AND TESTED ADD \$40

## FEATURES:

- ★ Uses new 2K x 8 (TMM 2016 or HM 6116) RAMs.
- ★ Fully supports IEEE 696 24 BIT Extended Addressing.
- ★ 64K draws only approximately 500 MA.
- ★ 200 NS RAMs are standard. (TOSHIBA makes TMM 2016s as fast as 100 NS. FOR YOUR HIGH SPEED APPLICATIONS.)
- ★ SUPPORTS PHANTOM (BOTH LOWER 32K AND ENTIRE BOARD).
- ★ 2716 EPROMs may be installed in any of top 48K.
- ★ Any of the top 8K (E000 HAND ABOVE) may be disabled to provide windows to eliminate any possible conflicts with your system monitor, disk controller, etc.
- ★ Perfect for small systems since BOTH RAM and EPROM may co-exist on the same board.
- ★ BOARD may be partially populated as 56K.

FULLY SUPPORTS THE NEW  
IEEE 696 S100 STANDARD  
(AS PROPOSED)

FOR 56K KIT  
\$449

## 16K STATIC RAMS?

The new 2K x 8, 24 PIN, static RAMs are the next generation of high density, high speed, low power, RAMs. Pioneered by such companies as HITACHI and TOSHIBA, and soon to be second sourced by most major U.S. manufacturers, these ultra low power parts, feature 2716 compatible pin out. Thus fully interchangeable ROM/RAM boards are at last a reality, and you get BLINDING speed and LOW power thrown in for virtually nothing.

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**TERMS:** Add \$2.00 postage. We pay balance. Order under \$15 add 75¢ handling. No. C.O.D. We accept Visa and MasterCard. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50, add 85¢ for insurance.



## COMPONENTS

SN7400N	18	SN7482N	30
SN7402N	22	SN7492N	49
SN7404N	21	SN7493N	45
SN7408N	22	SN7495N	50
SN7410N	18	SN7496N	60
SN7412N	20	SN74122N	29
SN7413N	22	SN74136N	95
SN7414N	29	SN74141N	60
SN7416N	27	SN74151N	39
SN7417N	29	SN74153N	55
SN7420N	17	SN74154N	125
SN7425N	24	SN74155N	55
SN7430N	17	SN74157N	58
SN7437N	26	SN74160N	89
SN7438N	24	SN74161N	65
SN7440N	18	SN74163N	85
SN7442N	45	SN74164N	87
SN7443N	42	SN74165N	85
SN7445N	64	SN74174N	86
SN7451N	19	SN74175N	79
SN7454N	19	SN74180N	115
SN7474N	27	SN74181N	115
SN7475N	35	SN74393N	165

### 74LS00

74LS00	28	74LS158	80
74LS02	28	74LS161	83
74LS03	28	74LS162	80
74LS04	28	74LS163	96
74LS05	22	74LS164	65
74LS08	29	74LS165	66
74LS09	28	74LS169	155
74LS10	26	74LS170	175
74LS14	89	74LS174	85
74LS20	22	74LS175	85
74LS21	26	74LS190	85
74LS26	40	74LS191	125
74LS27	27	74LS196	95
74LS28	37	74LS197	78
74LS30	29	74LS221	125
74LS32	31	74LS240	155
74LS38	31	74LS241	165
74LS42	63	74LS243	155
74LS48	77	74LS244	156
74LS74	38	74LS245	245
74LS75	55	74LS251	125
74LS88	45	74LS253	85
74LS90	59	74LS257	85
74LS93	85	74LS259	195
74LS98	80	74LS290	155
74LS107	43	74LS273	155
74LS113	45	74LS276	45
74LS122	45	74LS280	125
74LS123	89	74LS293	165
74LS125	89	74LS365	155
74LS126	79	74LS367	75
74LS138	64	74LS373	145
74LS139	59	74LS374	145
74LS151	49	74LS377	125
74LS153	49	74LS668	155
74LS157	89	74LS670	85

### 74S00

74S00	39	74S138	75
74S02	45	74S140	100
74S03	36	74S156	75
74S04	39	74S174	135
74S05	39	74S175	135
74S10	39	74S182	75
74S15	45	74S189	425
74S20	55	74S201	675
74S22	55	74S240	275
74S30	75	74S244	295
74S37	55	74S251	275
74S38	65	74S287	295
74S51	49	74S288	295
74S64	55	74S290	975
74S74	65	74S470	925
74S86	95	74S471	950
74S112	195	74S473	950
74S132	145	74S474	950

### EPROMS

2708	3.25sec	8 for 2.95ea
2716	5.50sec	8 for 5.00ea
2732	12.95sec	4 for 11.00ea

4116	300NS	2.00ea 8 for 14.00
	200NS	2.35ea 8 for 16.00

2114L	300NS	2.25 ea 4 for 1.90ea
200NS	2.45 ea 4 for 2.00ea	

2111	450NS	2.50ea 10 for 2.00ea
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### MISC.

2102	95	conf'd	
450NS			
8038	2.95	1103A	.75
MC6505	27	UPD785	19.85
ATD-1073A	4.25	Floppy disk controller	w/ tape
1488	95	ULN2001	1.95
8728	1.30	74S4400	1.40
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LM711	.25	10/14/70	26 10/3/80
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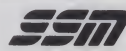
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SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

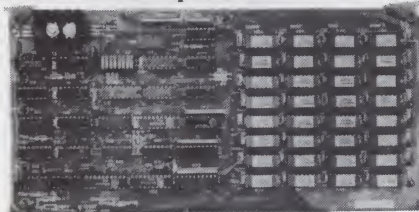
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4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

-All boards are assembled and tested-

## ExpandoRAM III

64K to 256K expandable RAM board



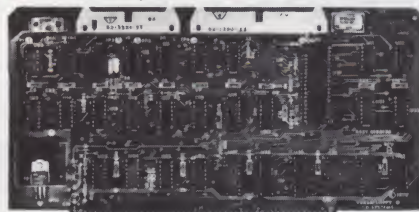
SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dynamic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A 64K A & T .....	\$495.00
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## Versafloppy II

Double density controller with CP/M 2.2



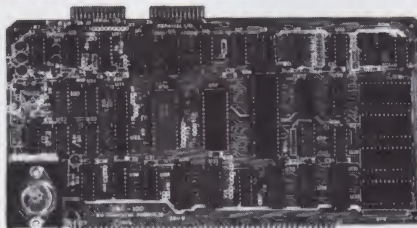
- S-100 bus compatible • IBM 3740 compatible soft sectored format • Controls single and double-density drives, single or double density, 5 1/4" and 8" drives in any combination of four simultaneously
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The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. CP/M 2.2 and all necessary control and diagnostic software are included.

IOD-1160A A & T with CP/M 2.2 .. \$370.00

## SBC-200

2 or 4 MHz single board computer



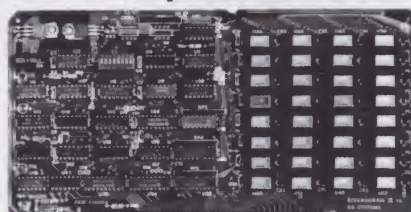
- S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud
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CPU-30200A A & T with monitor .. \$299.95

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- S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

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## COSMOS

Multi-user operating system

- Multi-user disk operating system • Allows up to 8 users to run independent jobs concurrently • Each user has a separate file directory

COSMOS supports all the file structures of CP/M 2.2, and is compatible at the applications program level with CP/M 2.2, so that most programs written to run under CP/M 2.2 or SDOS will also run under COSMOS.

SFC-55009039F COSMOS on 8" disk \$395.00

## Multi-User System

SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4  
COSMOS Multi-User Operating System, C BASIC II

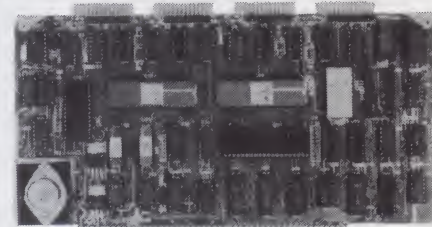
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Two Z-80A CPUs (4 MHz), 256K RAM, 5 serial I/O ports with independently programmable baud rates and vectored interrupts, parallel input port, parallel output port, 8 counter/timer channels, real time clock, single and double sided/single or double density disk controller for 5 1/4" and 8" drives, up to 36K of on-board ROM, CP/M 2.2 compatible COSMOS interrupt driven multi-user disk operating system, allows up to 8 users to run independent jobs concurrently, C BASIC II, control and diagnostic software in PROM included.

-All boards are assembled and tested-

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Intelligent communications interface



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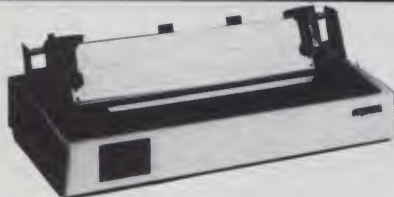
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IOI-2052K Serial kit ..... \$89.95  
IOI-2052A Serial A & T ..... \$99.95  
IOI-2054K Parallel kit ..... \$69.95  
IOI-2054A Parallel A & T ..... \$89.95

#### A488 - S.S.M.

IEEE 488 controller, uses simple basic commands, includes firmware and cable, 1 year guarantee, (see April Byte pg 11)  
IOX-7488A A & T ..... \$399.95

### Modems

#### CAT MODEMS - Novation

CAT 300 baud, acoustic, answer/originate  
IOM-5200A List \$189.95 ..... \$149.95  
D-CAT 300 baud direct connect, answer/originate  
IOM-5201A List \$199.95 ..... \$169.95  
AUTO-CAT Auto answer, originate, direct connect  
IOM-5230A List \$299.95 ..... \$239.95

#### Apple-CAT - Novation

Software selectable 1200 or 300 baud, direct connect, auto-answer, auto-dial, auxiliary 3-wire RS232C serial port for printer.  
IOM-5232A Save \$50.00!!! ..... \$325.00

#### SMARTMODEM - Hayes

Sophisticated direct-connect auto-answer/auto-dial modem, touch-tone or pulse dialing, RS-232C interface, programmable  
IOM-5400A Smartmodem ..... \$269.95

### Single Board Computer



#### AIM-65 - Rockwell

6502 computer with alphanumeric display, printer, & keyboard, and complete instructional manuals  
CPK-50165 1K AIM ..... \$424.95  
CPK-50465 4K AIM ..... \$474.95  
SFK-74600008E 8K BASIC ROM .. \$64.95  
SFK-64600004E 4K assembler ROM \$43.95  
PSX-030A Power supply ..... \$64.95  
ENX-000002 Enclosure ..... \$54.95  
4K AIM, 8K BASIC, power supply, & enclosure  
Special package price ..... \$649.95

#### Z-80 STARTER KIT - SD Systems

Complete Z-80 microcomputer with RAM, ROM, I/O, keyboard, display, kludge area, manual, & workbook  
CPS-30100K KIT ..... \$299.95  
CPS-30100A A & T ..... \$469.95

#### SYM-1 - Synertek Systems

Single board computer with 1K of RAM, 4K of ROM, key-pad, LED display, 20ma & cassette interface on board.  
CPK-50020A A & T ..... \$249.95

### Video Monitors

#### HI-RES 12" GREEN - Zenith

15 MHz bandwidth, 700 lines inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight & portable.  
VDM-201201 List price \$150.00 .... \$118.95

#### Leedex / Amdek

Reasonably priced video monitors  
VDM-801210 Video 100 12" B&W .. \$139.95  
VDM-801230 Video 100-80 12" B&W \$179.95  
VDM-801250 12" Green Phosphor ... \$169.95  
VDC-801310 13" Color I ..... \$379.95

#### 12" COLOR MONITOR - NEC

Hires monitor with audio & sculptured case  
VDC-651212 Color Monitor ..... \$479.95

#### 12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price  
VDM-651200 Special Sale Price .... \$199.95

### Video Terminals

#### AMBER SCREEN - Volker Craig

Detachable keyboard, amber on black display, 7 x 9 dot matrix, 10 program function keys, 14 key numeric pad, 12" non-glare screen, 50 to 19,200 baud, direct cursor control, auxiliary bi-directional serial port  
VDT-351200 List \$795.00 ..... \$645.00

#### VIEWPIONT - ADDS

Detachable keyboard, serial RS232C interface, baud rates from 110 to 19,200, auxiliary serial output port, 24x80 display.  
VDT-501210 Sale Priced ..... \$639.95

#### TELEVIDEO 950

VDT-901250 List \$1195.00 ..... \$995.00

#### DIALOGUE 80 - Ampex

VDT-230080 List \$1195.00 ..... \$895.00



# JADE

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## Computer Products

### S-100 CPU Boards

#### THE BIG Z\* - Jade

2 or 4 MHz switchable Z-80\* CPU with serial I/O, accommodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600

CPU-30201K Kit .....	\$139.95
CPU-30201A A & T .....	\$189.95
CPU-30200B Bare board .....	\$35.00

#### 2810 Z-80\* CPU - Cal Comp Sys

2 1/4 MHz Z-80A\* CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.

CPU-30400A A & T .....	\$269.95
------------------------	----------

#### CB-2 Z-80 CPU - S.S.M.

2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K Kit .....	\$239.95
CPU-30300A A & T .....	\$299.95

### S-100 PROM Boards

#### PROM-100 - SD Systems

2708, 2716, 2732 EPROM programmer w/software

MEM-99520K Kit .....	\$189.95
MEM-99520A A & T .....	\$249.95

#### PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer

MEM-99510K Kit .....	\$154.95
MEM-99510A A & T .....	\$219.95

#### EPROM BOARD - Jade

16K or 32K uses 2708's or 2716's, 1K boundary

MEM-16230K Kit .....	\$79.95
MEM-16230A A & T .....	\$119.95

### S-100 Video Boards

#### VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K 4 MHz kit .....	\$349.95
IOV-1095A 4 MHz A & T .....	\$439.95
IOV-1096K 80 x 48 upgrade .....	\$39.95

#### VDB-8024 - SD Systems

80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A\*.

IOV-1020A A & T .....	\$459.95
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#### VIDEO BOARD - S.S.M.

64 characters x 16 lines, 128 x 48 matrix for graphics, full upper lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1051K Kit .....	\$149.95
IOV-1051A A & T .....	\$219.95
IOV-1051B Bare board .....	\$34.95

### S-100 Motherboards

#### ISO-BUS - Jade

Silent, simple, and on sale - a better motherboard

6 Slot (5 1/4" x 8 3/4")

MBS-061B Bare board .....	\$19.95
MBS-061K Kit .....	\$39.95
MBS-061A A & T .....	\$49.95
12 Slot (9 3/4" x 8 3/4")	
MBS-121B Bare board .....	\$29.95
MBS-121K Kit .....	\$69.95
MBS-121A A & T .....	\$89.95
18 Slot (14 1/2" x 8 3/4")	
MBS-181B Bare board .....	\$49.95
MBS-181K Kit .....	\$99.95
MBS-181A A & T .....	\$139.95

### S-100 RAM Boards

#### MEMORY BANK - Jade

4 MHz, S-100, bank selectable, expandable from 16K to 64K

MEM-99730B Bare Board .....	\$49.95
MEM-99730K Kit no RAM .....	\$199.95
MEM-32731K 32K Kit .....	\$239.95
MEM-64733K 64K Kit .....	\$279.95
Assembled & Tested .....	add \$50.00

#### 64K RAM - Calif Computer Sys

4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A A & T .....	\$575.00
------------------------	----------

#### 64K STATIC RAM - Mem Merchant

64K static S-100 RAM card, 4-16K banks, up to 8MHz

MEM-64400A A & T .....	\$789.95
------------------------	----------

#### 32K STATIC RAM - Jade

2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K 16K 4 MHz kit .....	\$169.95
MEM-32151K 32K 4 MHz kit .....	\$299.95
Assembled & tested .....	add \$50.00

#### 16K STATIC RAM - Mem Merchant

4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A A & T .....	\$164.95
------------------------	----------

### S-100 Disk Controllers

#### DOUBLE-D - Jade

Double density controller with the inside track, on-board Z-80A\*, printer port, IEEE S-100, can function on an interrupt driven buss

IOD-1200K Kit .....	\$299.95
IOD-1200A A & T .....	\$375.00
IOD-1200B Bare board .....	\$59.95

#### DOUBLE DENSITY - Cal Comp Sys

5 1/4" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2\* and manual set.

IOD-1300A A & T .....	\$374.95
-----------------------	----------

### S-100 I/O Boards

#### S.P.I.C. - Jade

Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K 2 CTC's, 1 SIO, 1 PIO ..	\$179.95
IOI-1045A A & T .....	\$239.95
IOI-1046K 4 CTC's, 2 SIO's, 1 PIO ..	\$219.95
IOI-1046A A & T .....	\$299.95
IOI-1045B Bare board w/ manual ...	\$49.95

#### I/O-4 - S.S.M.

2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K Kit .....	\$179.95
IOI-1010A A & T .....	\$249.95
IOI-1010B Bare board .....	\$35.00

### S-100 Mainframes

#### MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

ENC-112105 Kit .....	\$329.95
ENC-112106 A & T .....	\$399.95

#### DISK MAINFRAME - N.P.C.

Holds 2 8" drives and a 12 slot S-100 system. Attractive metal cabinet with 12 slot motherboard & card cage, power supply, dual fans, lighted switch, and other professional features

ENS-112325 with 25 amp p.s. ....	\$699.95
----------------------------------	----------

### Disk Drives



Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

#### Dual 8" Subassembly Cabinet

END-000420 Bare cabinet .....	\$59.95
END-000421 Cabinet kit .....	\$225.00
END-000431 A & T .....	\$359.95

#### 8" Disk Drive Subsystems

##### Single Sided, Double Density

END-000423 Kit w/2 FD100-8Ds ..	\$924.95
END-000424 A & T w/2 FD100-8Ds ..	\$1124.95
END-000433 Kit w/2 SA-801Rs ...	\$999.95
END-000434 A & T w/2 SA-801Rs ..	\$1195.00

#### 8" Disk Drive Subsystems

##### Double Sided, Double Density

END-000426 Kit w/2 DT-8s .....	\$1224.95
END-000427 A & T w/2 DT-8s ...	\$1424.95
END-000436 Kit w/2 SA-851Rs ..	\$1495.00
END-000437 A & T w/2 SA-851Rs ..	\$1695.00

## QUME DT-8

8" Double-Sided, Double-Density Disk Drive

1 Drive ...	\$524.95 each
2 Drives ..	\$499.95 each
10 Drives	\$479.95 each

Jade Part Number MSF-750080

## Shugart 801R

8" Single-Sided, Double-Density Disk Drive

1 Drive ...	\$394.95 each
2 Drives ..	\$389.95 each

Jade Part Number MSF-10801R

## SIEMENS 8"

8" Single-Sided, Double-Density Disk Drive

1 Drive ...	\$384.95 each
2 Drives ..	\$349.95 each
10 Drives	\$324.95 each

Jade Part Number MSF-201120

## MPI B-51

5 1/4" Single-Sided, Double-Density Disk Drive

1 Drive ...	\$234.95 each
2 Drives ..	\$224.95 each
10 Drives	\$219.95 each

Jade Part Number MSM-155100

END-000213 Case & power supply .....	\$74.95
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Athana, BASF, Control Data, Dysan, IBM, Maxell, Nashua, Scotch, Shugart, Syncom, 3M, Verbatim or Wabash

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# MEMOREX

## for as low as \$1.94 each?

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Product Family	Product Description	Memorex Part Number (3201-1)	CE quant. 100 price per disc (\$)	Athana	BASF	Dysan	IBM	Maxell	Nashua	Scotch 3M	Shugart	Syncom	Verbatim	Wabash	Control Data
Flexible Disc 1a Single Headed Drives Single Density Media	IBM Compatible (126 S/S, 26 Sectors)	3060	1.90	473071	53426	800566	3305830	F01-126	FD-1	740-D	S/A 100	15002	FD34-8000	F111111X	421802
	IBM Compatible (126 S/S, 26 Sectors) w/ W.P.N. & Hub Ring	3062	2.04	—	—	—	—	—	—	740-D	—	—	FD34-8000	—	—
	IBM Compatible (126 S/S, 26 Sectors) REVERSIBLE	3064	2.36	—	—	—	—	—	—	—	—	—	FD34-8000	—	—
	IBM System 6 Compatible	1729	3.10	473072	54601	—	—	—	FD-2	740-D	—	15130	FF34-8000	F171111X	—
	IBM Compatible (256 S/S, 16 Sectors)	3066	2.04	473077	54601	800509	—	—	—	740-D 084	—	15003	FD40-8000	F181111X	—
	IBM Compatible (256 S/S, 16 Sectors)	3109	1.99	473073	—	800564	3305845	—	—	740-3600	—	15005	FD36-8000	F121111X	—
	IBM Compatible (512 S/S, 8 Sectors)	3110	1.99	473074	—	800565	1689554	—	—	—	—	15004	FD40-8000	F131111X	—
	Shugart Compatible, 32 Hard Sector	3015	1.99	470801	53802	101/1	—	FH1-32	FD-132	740-32	S/A 101	15025	FD32-8000	—	421322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3067	2.49	—	54491	—	—	—	—	740-32RH	—	—	—	FD34A11X	—
	CPI 8000 Compatible	3045	2.69	—	—	—	—	—	—	—	—	15226	—	—	—
Flexible Disc 1d Single Headed Drives Double Density Media	IBM Compatible (126 S/S, 26 Sectors)	3090	2.69	474071	54568	3740/10	—	FD1-126M2100	FD-1D	741-D	—	—	FD34-8000	F131111X	423002
	Soft Sector (126 S/S, 26 Sectors) REVERSIBLE	3093	3.69	—	—	—	—	—	—	—	—	—	—	—	—
	Shugart Compatible, 32 Hard Sector	3091	2.69	470801	54596	101/10	—	FH1-32D	—	741-32	S/A 103	15075	FD32-8000	FD34A11X	423327
	Wang Compatible, 32 Hard Sector w/Hub Ring	3098	3.09	—	—	—	—	—	—	—	—	—	—	—	—
Flexible Disc 1a Double Headed Drives Single Density Media	Soft Sector (126 S/S, 26 Sectors)	3113	3.09	—	54426	800814	1766870	—	—	—	S/A 180	15193	FD10-4000	F121111X	—
	Soft Sector (256 S/S, 16 Sectors)	3106	3.09	473477	54226	800816	2738700	FD2-256D	—	743-D	—	15184	FD10-401A	F122111X	424612
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Flexible Disc 2d Double Headed Drives Double Density Media	Soft Sector (Unformatted)	3102	3.09	473485	—	DY180	—	FD2-256M	FD-2D	743-D	—	15103	DD34-4001	—	425002
	Soft Sector (126 S/S, 26 Sectors)	3115	3.09	—	—	—	—	—	—	—	S/A 180	—	—	—	—
	Soft Sector (256 S/S, 16 Sectors)	3103	3.09	473471	54205	800817	1766872	FD2-256D	—	743-D/256	—	15101	DD34-4006	F146111X	425802
	Soft Sector (1412 S/S, 8 Sectors)	3114	3.09	473472	54479	800816	1689044	—	—	743-D/512	—	15100	DD34-4015	F145111X	425612
	Soft Sector (1024 S/S, 8 Sectors)	3104	3.09	473473	54485	800816	1689045	—	—	743-D/1024	—	15102	DD34-4008	F147111X	425622
	32 Hard Sector	3105	3.09	470851	—	101/20	—	FH2-32D	—	743-32	S/A 181	15126	DD32-4000	F34A411X	425322
	Burroughs S-80 Compatible, 32 Hard Sector	3092	3.09	—	—	—	—	—	—	—	—	—	—	—	—
	Soft Sector (1024 S/S, 8 Sectors) w/ Hub Ring	3118	3.49	—	—	—	—	—	—	—	—	—	—	—	—
	Shugart Compatible, 32 Hard Sector	3181	3.39	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Flexible Disc FD Memorex 851 or Equiv Drive Compatible	FD VI (Nimble Jacket)	30712003	2.69	470851	—	FDV	—	—	FD-185	811-D	—	15026	FD65-1000	F8A111X	—
Mini Flexible Disc 1a 5 1/4" Single Headed Single Density Media	Soft Sector (Unformatted)	3401	1.94	470901	54206	106/1	—	MD1	MD 1	744-D	S/A-104	15300	MD25-01	M11A211X	441002
	10 Hard Sector	3403	1.94	470910	54207	107/1	—	MD1	MD 110	744-10	S/A-107	15325	MD25-10	M41A211X	441102
	16 Hard Sector	3406	1.94	470916	54206	106/1	—	MD1	MD 118	744-16	S/A-106	15326	MD25-18	M51A211X	441182
	Soft Sector (Unformatted) w/Hub Ring	3431	2.14	—	—	—	—	—	—	—	—	—	MD25-01	—	—
	10 Hard Sector w/Hub Ring	3433	2.14	—	—	—	—	—	—	—	—	—	MD25-10	—	—
	16 Hard Sector w/Hub Ring	3436	2.14	—	—	—	—	—	—	—	—	—	MD25-18	—	—
Mini Flexible Disc 1d 5 1/4" Single Headed Double Density Media	Soft Sector (Unformatted)	3417	2.14	—	54646	104/10	—	—	—	—	—	—	MD25-01	—	—
	10 Hard Sector	3418	2.14	—	54649	107/10	—	—	—	—	—	—	MD25-10	—	—
	16 Hard Sector	3419	2.14	—	54652	106/10	—	—	—	—	—	—	MD25-18	—	—
	Soft Sector (Unformatted) w/Hub Ring	3481	2.34	—	—	—	—	—	—	—	—	—	MD25-01	—	—
	10 Hard Sector w/Hub Ring	3483	2.34	—	—	—	—	—	—	—	—	—	MD25-10	—	—
	16 Hard Sector w/Hub Ring	3485	2.34	—	—	—	—	—	—	—	—	—	MD25-18	—	—
Mini Flexible Disc 2d 5 1/4" Double Headed Double Density Media	Soft Sector (Unformatted)	3421	2.59	—	54674	104/20	—	—	—	—	S/A-144	—	MD50-01	—	—
	10 Hard Sector	3423	2.59	—	54677	107/20	—	—	—	—	S/A-157	—	MD50-10	—	—
	16 Hard Sector	3425	2.59	—	54630	106/20	—	—	—	—	S/A-155	—	MD50-18	—	—
	Soft Sector (Unformatted) w/Hub Ring	3481	2.79	—	—	—	—	—	—	—	—	—	MD50-01	—	—
	10 Hard Sector w/Hub Ring	3483	2.79	—	—	—	—	—	—	—	—	—	MD50-10	—	—
	16 Hard Sector w/Hub Ring	3485	2.79	—	—	—	—	—	—	—	—	—	MD50-18	—	—

## Memorex Flexible Discs...The Ultimate in Memory Excellence

### Quality

Memorex means quality products that you can depend on. Quality control at Memorex means starting with the best materials available. Continual surveillance throughout the entire manufacturing process. The benefit of Memorex's years of experience in magnetic media production, resulting, for instance, in proprietary coating formulations. The most sophisticated testing procedures you'll find anywhere in the business.

### 100 Percent Error Free

Each and every Memorex Flexible Disc is certified to be 100 percent error free. Each track of each flexible disc is tested, individually, to Memorex's stringent standards of excellence. They test signal amplitude, resolution, low-pass modulation, overwrite, missing pulse error and extra pulse error. They are torque-tested, and competitively tested on drives available from almost every major drive manufacturer in the industry including drives that Memorex manufacturers. Rigid quality audits are built into every step of the manufacturing process and stringent testing result in a standard of excellence that assures you, our customer, of a quality product designed for increased data reliability and consistent top performance.

### Customer-Oriented Packaging

Memorex's commitment to excellence does not stop with a quality product. They are proud of their flexible discs and their package them with pride. Both their packaging and their labeling have been designed with your ease of identification and use in mind. The desk-top box containing ten discs is convenient for filing and storage. Both box labels and jacket labels provide full information on compatibility, density, sectoring, and record length. Envelopes with multi-language care and handling instructions and color-coded removable labels are included. A write-protect feature is available to provide data security.

### Full One Year Warranty—Your Assurance of Quality

Memorex Flexible Discs will be replaced by Memorex if they are found to be defective in materials or workmanship within one year of the date of purchase. Other than replacement, Memorex will not be responsible for any damages or losses (including consequential damages) caused by the use of Memorex Flexible Discs.

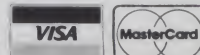
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Memorex Flexible Discs are packed 10 discs to a carton and 10 cartons to a case. Please order only in increments of 100 units for quantity 100 pricing. We are also willing to accommodate your smaller orders. Quantities less than 100 units are available in increments of 10 units at a 10% surcharge. Quantity discounts are also available. Order 500 or more discs at the same time and deduct 1%; 1,000 or more saves you 2%; 2,000 or more saves you 3%; 5,000 or more saves you 4%; 10,000 or more saves you 5%; 25,000 or more saves you 6%; 50,000 or more saves you 7% and 100,000 or more discs earns you an 8% discount off our super low quantity 100 price. Almost all Memorex Flexible Discs are immediately available from CE. Our warehouse facilities are equipped to help us get you the quality product you need, when you need it. If you need further assistance to find the flexible disc that's right for you, call the Memorex compatibility hotline. Dial 800-538-8080 and ask for the flexible disc hotline extension 0997. In California dial 800-672-3525 extension 0997.

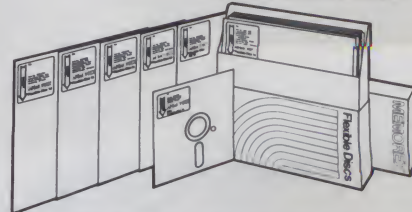
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450 n.s. .... 2.95  
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Style Pin Out. 14.95 8/\*105.00  
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Low Power Similar to 350 n.s.  
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TMM2016-2KX8 + 5v-NMOS  
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## DYNAMIC RAM

2107B-4 (MM5280N-5)-4KX1  
22 pin ..... 1.59  
4027-4KX1-250 n.s. .... 1.75  
\*4116-16KX1-300n.s.. 8/ 12.95  
\*4116-16KX1-200 n.s.. 8/15.95  
HM4164- + 5v 64K Dynamic  
Call or Write For  
Super Low Prices

## EPROM

\*Asterik Denotes Super Specials  
\*1702A 256X8 1 us 2.50  
2708 1KX8 450 n.s. 2.95  
27A08 1KX8 350 n.s. 3.95  
\*2716 2KX8 + 5v 450 n.s. 5.95  
\*2716-1 2KX8 + 5v 350 n.s. 9.95  
\*2732 4KX8 450 n.s. 14.95  
Intel Pin Out  
\*2532 4KX8 450 n.s. 14.95  
T.I. Pin Out

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Z80A-4MHZ CPU ..... \$8.95  
Z80PIO-Parallel ..... \$5.95  
Z80SIO/O-Z-80 2 Chan. Ser. \$24.95  
\*Z80DMA-DMA Controller ... \$9.95

## 80 80 SUPPORT

8216 Buffer \$1.95  
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\*TR1602-UART same as  
AY5-1013 ..... \$1.99  
\*IM6402- + 5v. High speed  
UART-AY5-1013 pin out \$3.95  
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and drive H.#. .... pair \$1.19  
AY3-8910-Sound Chip with 60  
page data manual ... \$12.95  
82S123-32X8 Tri State Bi polar  
PROM ..... \$3.99  
\*555-timer ..... 5/\$1.10

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AMD2901-4Bit Slice ..... \$7.95  
AMD2903-4 Bit Super Slice  
..... \$12.95  
AMD2911-Sequencer .... \$3.95  
AMD29705-16 Register Files  
..... \$4.95

## TTL

7400 .19 7474 .29  
7402 .19 7486 .29  
7404 .19 74109 .45  
7406 .19 74125 .49  
7408 .19 74154 1.19  
7410 .19 74175 .79  
7438 .22 74367 .59

## 74 LS

LS00 .24 LS123 .99 LS221 1.10  
LS04 .24 LS125 .95 LS240 .99  
LS05 .24 LS138 .79 LS241 .99  
LS10 .24 LS139 .79 LS244 .99  
LS14 .89 LS151 .79 LS245 1.95  
LS20 .24 LS153 .79 LS266 .59  
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LS30 .24 LS157 .79 LS293 1.75  
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LS74 .44 LS164 .99 LS368 .79  
LS85 .95 LS175 .89 LS373 .99  
LS86 .39 LS181 1.99 LS375 1.19  
LS90 .69 LS193 .89 LS377 1.49  
LS393 1.50

## VOLTAGE REGULATORS

7805 .99 7905 .99  
7812 .99 7912 .99  
7815 .99 7915 .99  
7824 .99 7924 .99  
\*LM323K-5v-3amp To-\$3.95 3/10.00

## 74-S

74S04 ..... \$ .39  
74S138 ..... .95  
74S240 ..... 1.99  
74S244 ..... 1.99

4116-300n.s. .... 8/12.95

2732A-3-4K x 8

350n.s. Intel Pin Out Low Power ..... 17.50

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## "TOP QUALITY PARTS FOR LESS"

### Precision Hybrid Oscillator Module

Has both 1 MHZ and 2 MHZ TTL - outputs — Hermetically sealed — Ultra high stability over wide temp. range — originally cost over \$40.00 each — We made a super purchase from a major computer manufacturer — 5 Volt operation - fits standard 24 pin socket - Manufactured by Motorola oscillator division.



MC6871A

3/20<sup>00</sup>

7<sup>50</sup> w/data

### NEO 2137 by NEC

- Microwave R.F. transistor (N.P.N.)
- Micromold package #37
- Dual Emitter leads
- FT to 4.5 GHz
- VCEO 10V-CC 20 MA. HFE 40-200
- Gain 10V-20MA-1GHZ = 14DB Typical
- Very low noise - High gain 1.5 DB @ 500 MHZ
- Cleared for high reliability space applications

COMPARE

1 50

### LM117

An easy to use adjustable Voltage Regulator only two external resistors needed to set the output voltage - TO-3 Case - adjustable from 1.2 to 37V Regulator is floating, so it can be used in a wide variety of applications, as long as the input-to-output differential voltage is 40V or less - 1.5A output current - house numbered prime Motorola

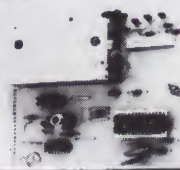


1 75

### Video Game Board

Hockey • Tennis • Handball

- General Instruments AY3-8500
  - Features Exciting Sounds
  - On Screen Scoring
  - 1 or 2 Players
  - Speed & Paddle Controls
  - Works on 9 Volts D.C.
- Each board comes with RF Modulator (Ch. 3 or 4) and schematic. The only parts needed to complete game are speaker, 2-1 Meg Pots & Switches.



4 45  
3 for 12<sup>00</sup>

### Video Paddle Controls

2 for 1<sup>00</sup>

Can be used with game board at left.



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As Seen on "Good Morning America"  
Replaces the Telephone Ringer Bell  
with a Selection of 30 Familiar Tunes



**Each Unit will play any of the following tunes:**

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- Wedding March
- Jingle Bells
- Auld Lang Syne
- Soldiers Chorus
- Sailor's Hornpipe
- Greensleeves
- Lorelei
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- Star Spangled Banner
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- Wilhelmus
- Mozart Sonata

**FEATURES**  
Replaces monotonous telephone ringer bell. Easily connects to any standard telephone. Can be used alongside regular phone or replace a remote ringer elsewhere in building or outside. FCC approved. Can be used on any telephone system — worldwide. Use a different tune to identify extension phones. Microprocessor controlled. Adjustable volume control and variable tune speed control. Operates on two 9-volt batteries or AC Adapter (not included).

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## 200(T 1/4) Red/Green

X C556R	200" red	3/51	MV50	.085" red	6/51
X C556G	200" green	4/51	X C209R	.125" red	5/51
X C556Y	200" yellow	4/51	X C209G	.125" green	4/51
X C556C	200" clear	4/51	X C209Y	.125" yellow	4/51
X C22R	200" red	5/51	X C526R	.185" red	5/51
X C22G	200" green	4/51	X C526G	.185" green	4/51
X C22Y	200" yellow	4/51	X C526Y	.185" yellow	4/51
MV10B	170" red	4/51	X C526C	.185" clear	4/51

C.C. — Common Cathode  
RHD — Right Hand Decimals

Type	Polarity	Ht	Price	Type	Polarity	Ht	Price
MAN 1	C.A.-red	270	2.95	DLG507	C.A.-green	.500	1.25
MAN 2	5x7 D.M.-red	300	4.95	DL704	C.C.-red	.300	1.25
MAN 3	C.C.-red	125	.25	DL707	C.C.-red	.300	1.25
MAN 52	C.A.-green	.300	.99	DL728	C.C.-red	.500	1.49
MAN 54	C.C.-green	.300	.99	DL741	C.A.-red	.600	1.25
MAN 71	C.A.-red	.300	.75	DL747	C.A.-red	.600	1.49
MAN 72	C.A.-red	.300	.75	DL760			

C.C.—red	.800	1.49
C.A.—orange	.800	1.49
C.C.—orange	.800	1.49

MAN 3620	C.C.-yellow	300	99	DL338	C.C.-red	110	35
MAN 3630	C.C.-orange	300	49	FND358	C.C. ±1	357	99
MAN 3640	C.C.-orange	300	99	FND357	C.C. ±1	357	99
MAN 6610	C.C.-orange	400	99	FND500	C.C. (FND500)	500	99
MAN 6616	C.C.-orange	400	99	FND507	C.C. (FND510)	500	99
MAN 6616	C.C.-orange-DD	560	99	HDS3401	C.C.-red	800	1.50
MAN 6640	C.C.-orange	1 560	99	HDS3402	C.C.-red	800	1.50
MAN 6640	C.C.-orange-DD	560	99	HDS3406	C.C.-red ±1	800	1.50
MAN 6650	C.C.-orange	1 560	99	5082-7751	C.C., R.H.D.-red	430	1.25
MAN 6660	C.C.-orange-DD	1 560	99	5082-7760	C.C., R.H.D.-red	430	1.25
MAN 6710	C.C.-red	560	99	5082-7761	4x7 Hexameric (RH.D)	220	1.25
MAN 6740	C.C.-red-DD	560	99	5082-7802	4x7 Hexameric (LH.D)	600	22.00
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DLO300	C.C.-orange	300	1.25	5082-7342	Photo Xistator Opto-Isol	600	99
DLO307	C.C.-orange	300	1.25	LIT-1	Photo Xistator Opto-Isol	600	99
DLG500	C.C.-green	500	1.25	MOC3010	Opto Xistator Triac Driver	1.25	

### CAPACITORS

	150	180	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5500	6000	6500	7000	7500	8000	8500	9000	9500	10000	11000	12000	13000	14000	15000	16000	17000	18000	19000	20000	22000	24000	26000	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	55000	60000	65000	70000	75000	80000	85000	90000	95000	100000	110000	120000	130000	140000	150000	160000	170000	180000	190000	200000	220000	240000	260000	280000	300000	320000	340000	360000	380000	400000	420000	440000	460000	480000	500000	550000	600000	650000	700000	750000	800000	850000	900000	950000	1000000	1100000	1200000	1300000	1400000	1500000	1600000	1700000	1800000	1900000	2000000	2200000	2400000	2600000	2800000	3000000	3200000	3400000	3600000	3800000	4000000	4200000	4400000	4600000	4800000	5000000	5500000	6000000	6500000	7000000	7500000	8000000	8500000	9000000	9500000	10000000	11000000	12000000	13000000	14000000	15000000	16000000	17000000	18000000	19000000	20000000	22000000	24000000	26000000	28000000	30000000	32000000	34000000	36000000	38000000	40000000	42000000	44000000	46000000	48000000	50000000	55000000	60000000	65000000	70000000	75000000	80000000	85000000	90000000	95000000	100000000	110000000	120000000	130000000	140000000	150000000	160000000	170000000	180000000	190000000	200000000	220000000	240000000	260000000	280000000	300000000	320000000	340000000	360000000	380000000	400000000	420000000	440000000	460000000	480000000	500000000	550000000	600000000	650000000	700000000	750000000	800000000	850000000	900000000	950000000	1000000000	1100000000	1200000000	1300000000	1400000000	1500000000	1600000000	1700000000	1800000000	1900000000	2000000000	2200000000	2400000000	2600000000	2800000000	3000000000	3200000000	3400000000	3600000000	3800000000	4000000000	4200000000	4400000000	4600000000	4800000000	5000000000	5500000000	6000000000	6500000000	7000000000	7500000000	8000000000	8500000000	9000000000	9500000000	10000000000	11000000000	12000000000	13000000000	14000000000	15000000000	16000000000	17000000000	18000000000	19000000000	20000000000	22000000000	24000000000	26000000000	28000000000	30000000000	32000000000	34000000000	36000000000	38000000000	40000000000	42000000000	44000000000	46000000000	48000000000	50000000000	55000000000	60000000000	65000000000	70000000000	75000000000	80000000000	85000000000	90000000000	95000000000	100000000000	110000000000	120000000000	130000000000	140000000000	150000000000	160000000000	170000000000	180000000000	190000000000	200000000000	220000000000	240000000000	260000000000	280000000000	300000000000	320000000000	340000000000	360000000000	380000000000	400000000000	420000000000	440000000000	460000000000	480000000000	500000000000	
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## SOLDERTAIL

(TIN) SOCKETS				STANDARD (TIN)			
	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	.17	.16	.17	14 pin ST	.27	.25	.24
14 pin LP	.20	.19	.18	16 pin ST	.27	.25	.24
16 pin LP	.22	.21	.20	18 pin ST	.35	.32	.32
18 pin LP	.28	.28	.27	24 pin ST	.49	.45	.42
20 pin LP	.34	.32	.30	28 pin ST	.69	.60	.58
22 pin LP	.37	.36	.35	36 pin ST	1.39	1.26	1.15
24 pin LP	.37	.38	.37	40 pin ST	1.59	1.45	1.30
28 pin LP	.45	.44	.43				
36 pin LP	.60	.59	.58				
40 pin LP	.63	.62	.61				

(GOLD) LEVEL #3

STANDARD				8 pin WW	.59	.54	.49
1-24				25-49	50-100		
8 pin SG	.39	.35	.31	14 pin WW	.69	.63	.58
14 pin SG	.49	.45	.41	16 pin WW	.79	.71	.67
16 pin SG	.59	.53	.49	18 pin WW	.89	.77	.70
24 pin SG	.79	.75	.69	24 pin WW	1.19	1.06	.99
28 pin SG	1.10	1.00	.90	22 pin WW	1.39	1.25	1.14
36 pin SG	1.40	1.25		28 pin WW	1.69	1.53	1.38
40 pin SG	1.75	1.59	1.45	36 pin WW	1.99	1.79	1.64
				40 pin WW	2.29	2.09	1.89

Part No.	Function	Price
70451P1	CMOS Precision Timer	1.00

7045E/Kit*	Stopwatch Chk, XLT	24
7106CPL	3/4 Digit A/D (LCD Drive)	16
7106E/Kit*	IC, Circuit Board, Display	34
7107CPL	3-Digit A/D (LED Drive)	25
7107E/Kit*	IC, Circuit Board, Display	29
7116CPL	3/4 Digit A/D LCD Dls. H.L.D.	18
7117CPL	3/4 Digit A/D LED Dls. H.L.D.	17
7201DIR	Low Battery Volt Indicator	2
7206IPG	CMOS LED Stopwatch/Timer	13
7206JCE	Stopwatch Chk, XLT	24
7206CPE	Tone Generator	5
7206CEV/Kit*	Tone Generator Chk, XTL	12
7207AID	Oscillator Controller	7
7207E/Kit*	Freq. Counter Chk, XTL	13
7208IPJ	Seven-Digit Counter	17
7209AIP	Clock Generator	3
7215IPG	4 Func. CMOS Stopwatch CKT	13
7215E/Kit*	4 Func. Stopwatch Chk, XTL	19
7216CPL	8-Digit Freq. Counter C.C.A.	26
7216CJL	8-Digit Freq. Counter C.C.	26
7216DPI	8-Digit Freq. Counter C.C.	21
7217JLJ	4-Digit LED Up/Down Counter	8
7218CPL	8-Digit Univ. LED Counter	11
7224IPJ	LCD 4 1/2 Digit Up Counter DRI	11
7226AJJL	8-Digit Univ. Counter	31
7226E/Kit*	5 Function Counter Chk, XTL	74
7226CPE/Kit*	5 Function Counter Chk, XTL	74
7242AJA	CMOS Divide-by-256 RC Timer	2
7250JE	CMOS BCD Prog. Timer/Counter	6
7250JJE	CMOS BCD Prog. Timer/Counter	6
7250JCE	CMOS BCD Prog. Timer/Counter	6
7556DIP	CMOS 556 Timer (4 pin)	2
7611BCPA	CMOS Op Amp Comparator	5MV 27
7612BCPA	CMOS Op Amp Ext. Cmvr.	5MV 27
7613BCPE	CMOS Dual Op Amp Comp.	5MV 31
7614CCPE	CMOS Op Amp Comp. 10MV	7
7641CCPD	CMOS Quad Op Amp Comp.	10MV 7
7642CCPD	CMOS Quad Op Amp Comp.	10MV 7
7650CPA	Voltage Converter	2
7650CPE	Warm Generator	2
8048CPE	Monolithic Logarithmic Amp	21
8069CQC	500ppm Band-GAP Volt. Ref. Diode	2
8070CQC	Volt. Indicator	2
8212CPA	Volt. Ref/Indicator	2

74C02	.39	74C95	1.59	74C240	2.00
74C04	.39	74C107	1.89	74C244	2.00
74C08	.39	74C151	2.05	74C373	2.00

74C10	.39	74C154	1.95	74C734	2
74C14	.75	74C157	2.25	74C901	
74C20	.39	74C160	1.69	74C903	
74C30	.39	74C161	1.60	74C911	10
74C42	1.39	74C163	1.69	74C912	10
74C48	.75	74C164	1.69	74C915	10
74C73	.75	74C165	1.69	74C917	10
74C74	.79	74C173	1.39	74C922	5
74C85	1.95	74C174	1.39	74C923	5
74C86	.99	74C175	1.19	74C925	7
74C89	6.95	74C192	1.69	74C926	
74C90	1.29	74C193	1.69	80C95	
74C93	1.29	74C195	1.94	80C97	

LM10CLH	4.50	<b>LINEAR</b>	LM703CN		
LM11CLH	4.75		LM340T-5	1.25	LM709N
LM10070-CH	4.95		LM340T-10	1.05	LM73100
LM10070-CH	4.95		LM340T-12	1.05	LM73100

TL0701C	4.30	LM340T-12	1.25	LM710N
TL071CP	1.99	LM340T-15	1.25	LM711N
TL072CP	1.39	LM341P-5	.75	LM723N
TL074CN	2.49	LM341P-12	.75	LM733N
LM0082CD	35.80	LM341P-15	.75	LM739N
TL082CP	1.19	LM342P-5	.69	LM741CN
TL084CN	2.19	LM342P-12	.69	MC1741SCG
LM0094CD	36.80	LM342P-15	.69	LM747N
LM300H	.99	LM348N	1.25	LM748N
LM3101CN	.35	LM350K	5.75	LM1014N
LM302H	1.95	LF351N	1.60	LM1310N
LM304H	1.95	LF353N	.60	LM1458CN

LM308CN	1.00	LM358N	1.00	LM1496N	1
LM309H	1.95	LM359N	1.79	LM1556V	1

LM309K	1.25	LM370N	4.49	LM1800N	2
LM310CN	1.78	LM373N	3.25	LM1871N	5
LM311/CN	90	LM377N	1.95	LM1872N	2
LM312H	2.49	LM380N	1.25	LM1877N-9	3
LM317MP	1.15	LM381N	1.95	LM1889N	3
LM317T	1.78	LM382N	1.79	LM1896N	1
LM317K	3.95	LM384N	1.95	LM2002T	2
LM318CN	1.95	LM386N-3	1.29	LM2877P	2
LM319N	1.95	LM387N	1.45	LM2878P	2
LM320K-5	1.35	LM389N	1.35	LM2896P-1	2
LM320K-12	1.35	LM392N	.69	LM3189N	2
LM320K-15	1.35	LF398N	4.00	LM3900N	2

### CAPACITOR CORNER

#### 50 VOLT CERAMIC DISC CAPACITORS

ASST. 1	5ea.	27 Ohm	33 Ohm	39 Ohm	47 Ohm	56 Ohm	50pcs.	\$1.95
		68 Ohm	82 Ohm	100 Ohm	120 Ohm	150 Ohm		
ASST. 2	5ea.	180 Ohm	220 Ohm	270 Ohm	330 Ohm	390 Ohm	50pcs.	\$1.95

ASST. 3	5ea.	470 Ohm	560 Ohm	680 Ohm	820 Ohm	1K	50pcs.	\$1.95
		1.2K	1.5K	1.8K	2.2K	2.7K		

ASST. 4	5 ea.	3.3K	3.9K	4.7K	5.6K	6.8K		
		8.2K	10K	12K	15K	18K	50pcs.	\$1.95
		22K	27K	33K	39K	47K		

ASST. 5	5 ea.	56K	68K	82K	100K	120K	50 pcs.	\$1.95
		150K	180K	220K	270K	330K		
ASST. 6	5 ea.	390K	470K	560K	680K	820K	50 pcs.	\$1.95

		1M	1.2M	1.5M	1.8M	2.2M		
ASST. 7	5ea.	2.7M	3.3M	3.9M	4.7M	5.6M	50pcs.	\$1.95
ASST. 8B	Includes Resistor Assys. 1.7 (250 pcs.)							\$10.05

ASST. 8H	Includes Resistor Assts. 1-7 (350 pcs.)	\$10.95 ea.
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.01mf	.12	.10	.07	.2mf	.32	.20

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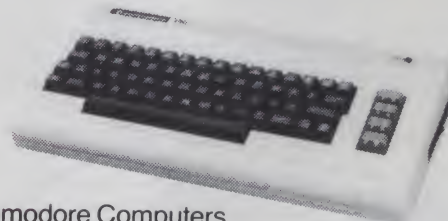
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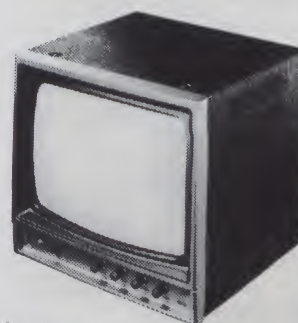


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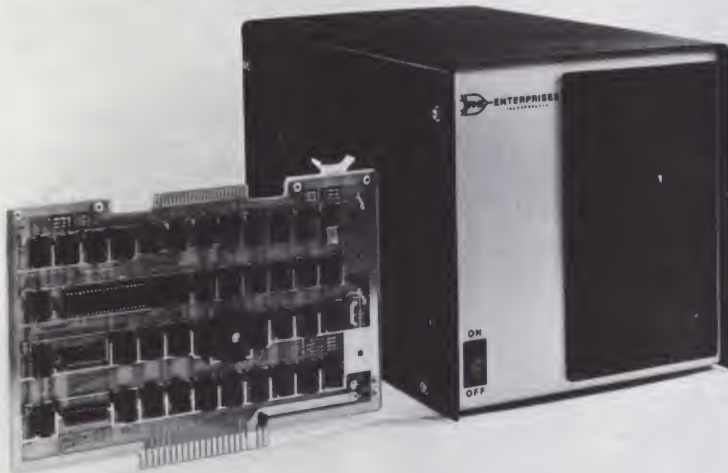
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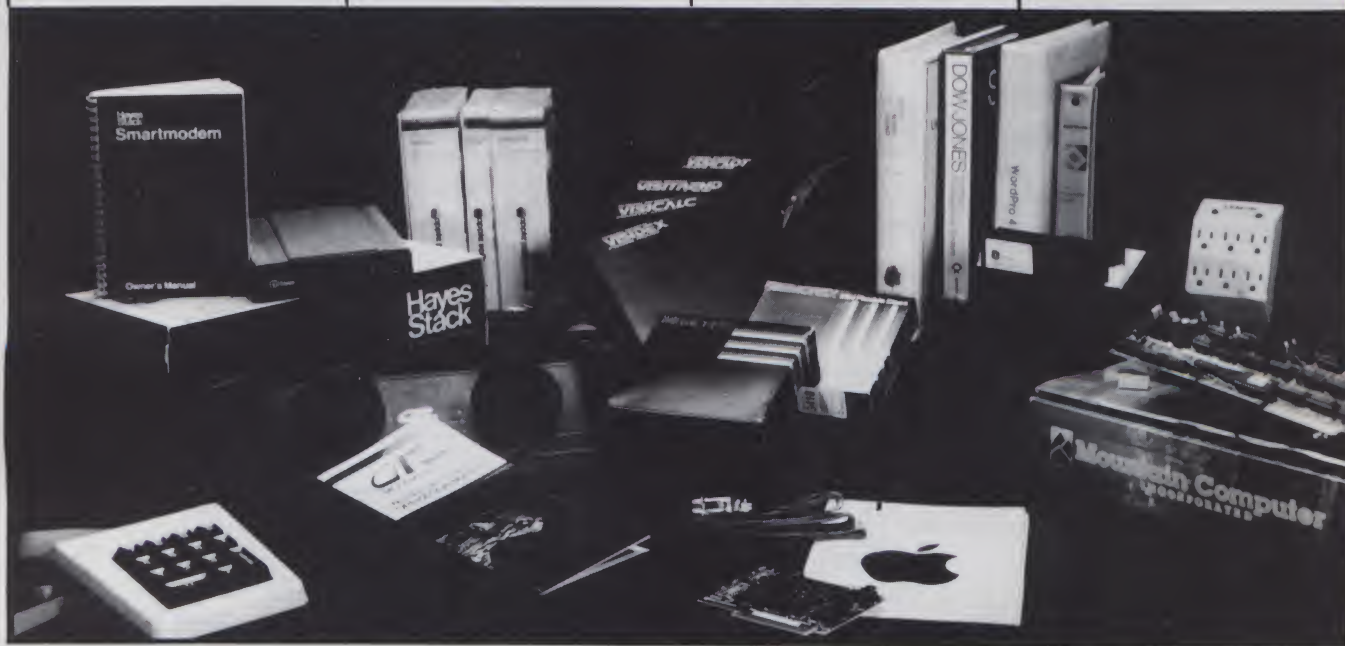
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- 1 Apple
- 2 Altair
- 3 Exidy
- 4 Heath
- 5 Hewlett-Packard
- 6 North Star
- 7 OSI
- 8 PET/IBM
- 9 SWTP
- 10 TI
- 11 TRS-80
- 12 Other \_\_\_\_\_

**B. How much have you invested in hardware (including peripherals)?**

- 1 \$1000-\$2000
- 2 \$2001-\$3000
- 3 \$3001-\$4000
- 4 More than \$4000

**C. What will be your next major hardware purchase?**

- 1 Printer
- 2 Modem
- 3 Disk System
- 4 Other \_\_\_\_\_

**D. On average, how many of each issue's program listings do you actually type into your micro?**

- 1 0-2
- 2 3-5
- 3 6-8
- 4 9 or more

**E. How much have you spent on software?**

- 1 Less than \$100
- 2 \$100-\$250
- 3 \$251-\$500
- 4 \$501-\$1000
- 5 Over \$1000

**F. How do you acquire your software?**

- 1 I program it myself
- 2 From magazines
- 3 From friends and fellow programmers
- 4 From software houses

**G. From what companies have you purchased software?**

- 1 Hayden
- 2 Hewlett-Packard
- 3 Instant Software
- 4 Microsoft
- 5 Personal Software
- 6 SAMS
- 7 Other \_\_\_\_\_

**H. To what types of software users groups do you belong?**

- 1 Hardware exclusive
- 2 General club
- 3 College organization
- 4 Other \_\_\_\_\_

**I. How many people read your copy of Kilobaud Microcomputing?**

- 1 1
- 2 2
- 3 3
- 4 4 or more

**J. Where did you obtain this copy of Kilobaud Microcomputing?**

- 1 Subscription
- 2 Newsstand
- 3 Computer store
- 4 Friend
- 5 Other \_\_\_\_\_

**K. Which cover style do you prefer for this magazine?**

- 1 The old table of contents cover
- 2 The newer picture-type cover
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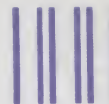
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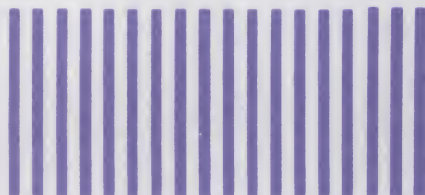
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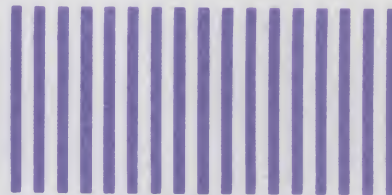
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# LETTERS

(from page 30)

cut out a lot of unnecessary searching and time. For example, I was able to reduce one benchmark program's overall processing time from 10 minutes down to five. Not bad!

The second improvement was to merge the Spooling program with the main FILEMAP program (presuming you can afford the memory space). I simply added it on the end of the program and added a GOTO1300 at the end of line 820. Also, I altered the original Spool program to give me the option of displaying it out on the CRT or printer (see attached lines 1300-1400).

**Michael W. Tolmasoff**  
Healdsburg, CA

## More on Software

This letter is written in response to a spate of complaints regarding the poor quality of software and the subject of software theft appearing in trade magazines.

Since the shortage of good software is generally that classed as applications software, my discussion is generally limited to that class. Some of these complaints are:

- A general belief that programs presently being distributed without source code are not usable, that they are either unsuitable in nature or full of errors.

- The software vendor has a "stranglehold" on the market, as one writer suggests. Hence, the pricing is unreasonable. Also a stated belief that if the price was "reasonable" the market base would be broadened, purportedly making it not profitable to copy.

There are problems in the securing of well-designed and executed software. There are about three ways to get good software.

- Contract with a programming house for your needs. This may be the only way on occasion, but it will not be cheap.

- Purchase a package with the source code included. Now, it is a fact that the better-designed a package is the more costly to produce, and the more carefully debugged and documented, the less likelihood that the software will be released at cassette-program prices. Do you really want to go through revision and retesting of package software? It takes a lot of accounting and programming and design background to execute a wall-to-wall ac-

counting package. What makes you think you can do it? So far, few persons of any background have done so, though the magazines are full of hopefuls.

- Purchase a previously-tested set of programs with support from the vendor as to modifications needed. No software should be purchased without spending considerable time seeing it in operation. If you don't see it work, don't buy it. Study the manual, discuss the operations in detail with your CPA and your employees who will have to use the programs.

It is not likely that applications software (a typical program-set runs about 1000 pages of code) will ever be priced at \$39.95. The mere writing of a carefully tailored program limits its use. Programs which purport to serve everybody serve no one well. The potential users will run only into the hundreds, not the hundreds-of-thousands that games and word-processing programs or utilities can expect. It also takes a long time to write. How does five or six man-years grab you?

The present market and unusable copyright or patent laws do not protect the developer but in fact encourage theft. There are not many good applications out there. Do you really think that wholesale theft will reduce the price to the user? The thief intends to market the loot for all he can get. He is not a Robin Hood.

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Insofar as reducing the price to a point where it will be unprofitable to steal, forget it. A greedy person can never have enough of wealth, nor is there any level below which he will not stoop to steal.

**Gorden R. Page**  
Turnkey Business Systems  
Philadelphia, PA

### North Star DOS Edit Change

When I finally sold my SOL-20 and the North Star disk system, I ordered a new Horizon and Soroc terminal. One of the things I noticed was that the arrows did not work when editing in BASIC as they did on the SOL-20. When I decided to try and change this, I went all the way and have most of the edit commands on a single key.

The program simply rewrites the port 0 input routine to check for the input of arrows or the escape key. (See Listing 2.) If these characters are input, they are

changed to the proper control characters for editing.

I did this on LF DOS 8000H and I used the monitor to do the changes (starting at 8800 instead of 2900) then did an SF DOS 8000 and it all worked fine on my release S.O. version of DOS 5.2.

**E.B. Robinson**  
Belleville, Ontario

### Handy Hexpad

The following suggestion is for all two-finger typists like myself who find entering hex data with TBUG a pain.

This small modification to TBUG (only 15 bytes) should make life much simpler by converting the numeric keypad into a very handy hexpad. Using the right thumb on the shift key, it is easy to key in A to F with shift-1 to shift-6.

The following code changes are made to TBUG by itself:

2900	FE02	CP1 2	Check for dev. 2
2902	CA2229	JZ 2922	Jump if parallel port
2905	FE01		Check for dev. 1
2907	CA1629	JZ 2916	Jump if second serial port
290A	C3BD29	JP 298D	Assume port 0
			New Port 0 Routine
29BD	DB03	IN 3	Input serial port status
29BF	E602	AN1 2	Mask input status bit
29C1	CAB029	JZ29BD	Jump if no character
29C4	DB 02	IN2	Get character
29C6	E67F	AN1 7F	Mask off parity bit
29C8	FE0C	CP1 0C	Check for right arrow
29CA	CA DD29	JZ 29DD	Jump to 29DD if right arrow
29CD	FE0A	CP1 0A	Check for up arrow
29CF	CAE029	JZ 29E0	Jump to 29E0 if up arrow
2902	FE0B	CP1 0B	Check for down arrow
29D4	CAE329	JZ29E3	Jump to 29E3 if down arrow
29D7	FE1B	CP1 1B	Check for "esc" Key
29D9	CAE629	JZ29E6	Jump to 29E6 if "esc"
29DC	C9	Ret	Return with character in A
29DD	3E01	Mov A 01	Move 01 into A
29DF	C9	Ret	Return
29E0	3E 19	Mov A 19	Move 19 into A
29E2	C9	Ret	Return
29E3	3E 1A	Mov A 1A	Move 1A into A
29E5	C9	Ret	Return
29E6	3E 07	Mov A 07	Move 07 into A
29E8	C9	Ret	Return

Listing 2.

```
45BB FA8149 JP M,4981H
4981 FE21 CP 21H ;"I"
4983 FAA445 JP M,45A4H
4986 FE27 CP 27H ;"I"
4988 F2A445 JP P,45A4H
498B D617 SUB A,17H
498D C9 RET
```

The code changes will cause a branch out of the keyboard scan routine at 45BBH when the ASCII value in register A is less than 30H (0). Two tests are then made to assure that the value in register A is in fact one of the six shifted values (21H to 26H). Subtracting 17H from (or adding E9H to) register A returns the desired values to the screen.

After the changes to TBUG have been made, you can save the modified version of TBUG by typing: P 4380 498D 4380 TBUG# (ENTER). This modification to TBUG has eased my code entry considerably, although now my right thumb is taking the beating that my index fingers once got!

**John C. Klassen**  
Winnipeg, Manitoba

### Sorcery with OSI

When I saw the article in the June 1981 issue of *Microcomputing*, "Teach a Sorcerer New Tricks" (p.76), I wondered if it could be adapted to OSI. It can and it works 100 times faster when renumbering one of my game programs which is over 5000 bytes long.

The changes for use with an OSI are: 6500 becomes 63000 (65000 doesn't work for some reason). ZB = 768 (not 468 —OSI program space starts at 0300 H).

The tokens are slightly different: GOTO = 136 (not 137).

RUN = 137.  
GOSUB = 140 (not 141).  
THEN = 160 (not 162).

I also added one line:

63197 IFCV = 137 ORCV = 160 THEN 63185.

One other small point. In the original program, if the line number increased from one or two digits to three or four, the ampersand (&) was printed. In the second program in the same situation, an error message is printed on the screen.

To correct this all you have to do when you are typing your program is put a number of spaces before the number so the spaces and number total four. For example

```
100 IF X THEN 999
100 IF X THEN 999
```

(You don't need spaces in OSI Microsoft BASIC.)

This way when you renumber either up or down you do not have an error message, you have a correctly renumbered program.

**Jim Verdon**  
Sarnia, Ontario

### Lousy Software

Wayne Green's editorial in the September *Microcomputing* mentions the problem of lousy software. God



knows that there is an awful lot of it floating around this world. The primary aspect of the problem is not even programs containing actual bugs (these rarely get off the ground at all), but rather programs that are inefficient and/or poorly designed. In particular, the tendency of programmers to try to design and write everything absolutely from scratch, without regard to advances in the state of the art made by others, continues to result in unwieldy, restriction-filled programs even when techniques for eliminating these kinds of characteristics are well-established.

The kicker is that *Microcomputing* actually contributes to this problem due to the kinds of reviews that you choose to publish. I have never once encountered a single review in your magazine which effectively counseled the reader not to buy the program being reviewed, or that explicitly suggested that a competing program embodied a better approach to the task at hand.

Now, I understand that a magazine can get itself into trouble with its advertisers by bringing points like this to the attention of readers. In fact, this alone, I'm sure, accounts for your reluctance to do so. But, by the same token, it seems sort of pointless to take up space in your magazine printing reviews that the reader has to take with such a large grain of salt

that he might as well not read them in the first place. Because many readers do not have the technical expertise necessary to sift the wheat from the chaff in dealers' demonstrations, one would hope that the whole point of a review is to provide the reader with an expert opinion on the pros and cons of a particular product.

**Timothy Stryker**  
Pompano Beach, FL

*It also seems sort of pointless to take up space in our magazine printing reviews of products that don't deserve to be in the marketplace in the first place. Why should you waste your time reading about them? We feel that any publicity—whether it is good or bad—given to a really rotten product is free publicity that the company doesn't deserve. Thus, we limit our coverage in the magazine's review sections to those products deserving of review, which our authors examine from both sides of the fence. And, it goes without saying that we do not limit our articles to those covering advertisers' products. We do not patronize our advertisers in our review section and do not bother reviewing products that we determine to be trash. Conclusion: Be very careful about buying products that have not been reviewed in Microcomputing.—Editors.*

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## **National Careers for the Disabled Symposium**

The first National Careers for the Disabled Symposium will be sponsored by Commodore Business Machines, Inc., in association with Careers for the Disabled, Inc. The symposium will be held on Dec. 4-6, 1981, at the Convention Center in Baltimore, MD.

For additional information contact Careers for the Disabled, 261 Madison Ave., Suite 1102, New York, NY 10016.

## **Teleconferencing Technologies Seminar**

The Teleconferencing Technologies Seminar will be held at the Hilton Harvest House, Boulder, CO, on Dec. 7 and 8, 1981. The seminar will focus on how to use teleconferencing to conduct business transactions and improve effectiveness and decision-making. Demonstrations of computer, video and audio teleconferencing will be conducted, offering hands-on experience.

The seminar is jointly sponsored by Cross Communications Co. and Colorado Video, Inc.

The cost of the seminar is \$395, exclusive of meals and housing.

For further information contact Cross Communications Co., 934 Pearl, Boulder, CO 80302 (303-499-8888).

## **National Conference on Computer Graphics**

The National Conference on Computer Graphics will be held Dec. 7-9 in Washington, D.C. The conference will spotlight trends in the application of computer graphics. Graphics equipment and demonstrations will be included.

Contact U.S. Professional Development Institute, 12611 Davan Dr., Silver Spring, MD 20904 (301-622-0066).

## **Second International Conference on Information Systems**

The Second International Conference on Information Systems will be held in Boston, MA, Dec. 7-9.

For more information contact E.R. McLean, Graduate School of Management, University of California, Los Angeles, CA 90024 (213-825-2502).

## **Alpha Micro User's Society Convention**

The second annual Alpha Micro User's Society convention will be held at the Deauville Hotel in Miami Beach, FL, the week of January 24-29, 1982. Demonstrations and workshops will be held on data communications, assembly language, structured programming and other subjects. Meetings will be held for institutions such as hospitals and schools, and special interest sessions will be held for the exchange of information about word processing, database management and business applications. Membership in the Alpha Micro User's Society is a prerequisite for attendance. Dues are \$35, which includes a

subscription to the monthly newsletter.

For further information, contact AMUS at 1911 11th St., Suite 210, Boulder, CO 80302 (303-449-6917).

## **Unix Tutorials**

Three days of tutorials on the Unix computer operating system and the C programming language will be held January 11-13, 1982, in San Francisco, sponsored by Uni-Ops, a user's association.

Bulletins with full information on the tutorials are available from Uni-Ops, PO Box 5182, Walnut Creek, CA 94596 (415-933-8564).

## **First Annual Pacific Computer Exposition**

The first annual Pacific Computer Exposition will be held at the San Diego Convention and Performing Arts Center, Jan. 21-23, 1982.

The computer show will feature software and hardware of interest to business, industry, education and homeowners. At least 200 exhibitors will participate in the exposition.

Detailed information for exhibitors is available by contacting Taylor R. Coleman at Judco Enterprises of Scottsdale, AZ (602-990-1751).

## **Consumer Electronics Show**

The winter International Electronics Show will be held at the Las Vegas Convention Center Jan. 7-10.

For further information contact William T. Glasgow, Vice President, Consumer Electronics Shows, Two Illinois Center, Suite 1607, 233 North Michigan Ave., Chicago, IL 60601 (312-861-1040).

## **Micros in Education**

Arizona State University is hosting the tenth annual Math/Science Conference on Jan. 15 and 16, 1982. The conference will focus on the microcomputer as a tool for instruction, as a research instrument and as an information manager.

For further information contact Nancy Watson, Conference Codirector, 203 Payne Hall, Arizona State University, Tempe, AZ 85287.

## **ACM Annual Computer Science Conference**

The ACM Annual Computer Science Conference will be held Feb. 9-11, 1982, in Indianapolis, IN.

For more information contact Marshall Yovits, Indiana-Purdue University, 1125 E. 38 St., Indianapolis, IN 46205 (317-923-1321).

## **Interface Conferences**

The Interface Group will hold the following major conferences and expositions for the computer industry: Federal DP Expo, Washington, DC, February 22-24; INTERFACE '82, Dallas, March 22-25; and COMDEX/SPRING, Atlantic City, June 28-30. For more information, contact The Interface Group, 160 Speen St., Framingham, MA 01701 (800-225-4620).



## Texas Computer Show Postponed

James E. Myles, group show manager for Intercontinental Trade Shows Inc., has announced that the Texas Computer Show, scheduled to take place in the Dallas Convention Center from Jan. 20-22, 1982, has been postponed until March 9-11, 1983.

For more information contact James E. Myles (416-252-7791) or Catherine Manor (214-761-9108).

## Tutorial Week East and Southcon '82

The Computer Society of the Institute of Electrical and Electronics Engineers, Inc. (IEEE-CS), will hold a week of tutorials March 22-26, 1982, at the Orlando Marriott Inn, Orlando, FL.

Participants may take up to five tutorials for the full-week registration fee of \$400 (IEEE members) or \$500 (non-members). Registration fees for individual tutorials are \$90 for IEEE members and \$110 for non-members.

For further information and a program for Tutorial Week East, contact Tutorial Week East, IEEE Computer Society, PO Box 639, Silver Spring, MD 20901.

The annual IEEE Southcon '82 will be held March 23-25 in Orlando and free shuttle service will be offered between Southcon and TWE. Southcon will feature over 50 technical sessions and over 500 exhibitors.

For further information on Southcon, write Dale Litherland, 999 North Sepulveda Blvd., Suite 410, El Segundo, CA 90245.

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# Memory Expansion Boards

## SS-50 Synthesizers

## Mini-disk Storage Systems

## Epic Microcomputer

## Apple Speedup

### Field-Expandable Memory Board

Teletek's new S-100 memory boards can be furnished with any of three different random access memory devices—4116, 4516 or 4164 chips. The basic board is a 64K-byte bank-select unit with memory deselection on any 4K boundary. The board is normally supplied with 4116s for any version between 16K and 64K bytes. It can later be expanded up to 256K. The 128K, 192K or 256K versions are populated with 4164 chips. The unit operates at 4 MHz with no wait states, and will operate at 6 MHz with one wait state. It can be used with a wide range of 8080, Z-80, 8085 or Alpha Micro processors.

Teletek, 9767F Business Park Drive, Sacramento, CA

95827. Reader Service number 489.

### Two Sound Products

Speech Systems, 38 W 255 Deerpath Road, Batavia, IL 60510, is offering two new products for the SS-50 bus. These versatile synthesizers can reproduce speech, music and sound effects. The Speak 'n'Sing 1 uses the SC-01 phoneme speech chip by Votrax to synthesize speech with an unlimited vocabulary. The Speak'n'Sing 2 uses the National Semiconductor DigitaTalker speech synthesis technique to reproduce a limited number of words with exceptional clarity. Both synthesizers incorporate their own FIFO buffers to free the processor for other tasks. This feature eases program devel-



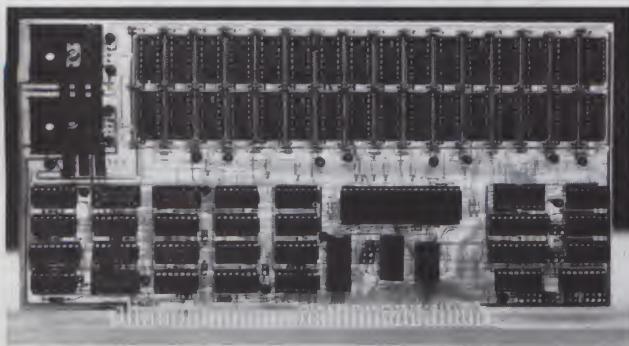
Percom Data Company's disk storage system and adapter.

opment and is important in real-time applications. Music and sound effects are developed using an eight-bit digital-to-analog converter. Available software includes utility programs, games using speech as their output, several one- and four-voice music selections and sound effects, and is available on five-inch and eight-inch disks in both Flex 2.0 and Flex 9.0 formats. Speak'n'Sing 1 is priced at \$219.95; Speak'n'Sing 2 is \$239.95. Reader Service number 491.

### Mini-Disk Storage For AIM-65

Percom Data Company,

211 N. Kirby, Garland, TX 75042, is now supplying mini-disk storage systems for AIM-65, KIM and SYM computers, and an adapter which interfaces these computers to the System-50 SS-50 motherboard. The M-65/50 adapter permits expansion of an AIM-65, KIM or SYM with proven System-50 modules. The MFD mini-disk systems are available in one-, two- and three-drive units. A system includes a disk controller circuit card, disk-operating system, interconnecting cable, user's manual and the drives. Two controllers are available, one for the AIM-65 expansion bus and one for the System-50 bus. MFD drive systems are



Teletek's 64K-256K memory board.





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Either controller can be used with any combination of 5" and/or 8" drives, up to 4 drives total, have data recovery circuits (data separators), and are designed to fully meet the timing requirements of the controller I.C.s.

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Chart shows total capacity in Bytes for 2 drives.

Contact GIMIX for price and availability of 8" floppy disk drives and cabinets; and 5" and 8" Winchester hard disk system.

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for 50 Hz export power supply, add ..... 30.00

**NOTE: UNIFLEX can not be used with 5" minifloppy drives.**

GIMIX has a wide variety of RAM, ROM, Serial and Parallel I/O, Video, Graphics, and other SS50 bus cards that can be added now or in the future. Phone or write for more complete information and brochure.

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
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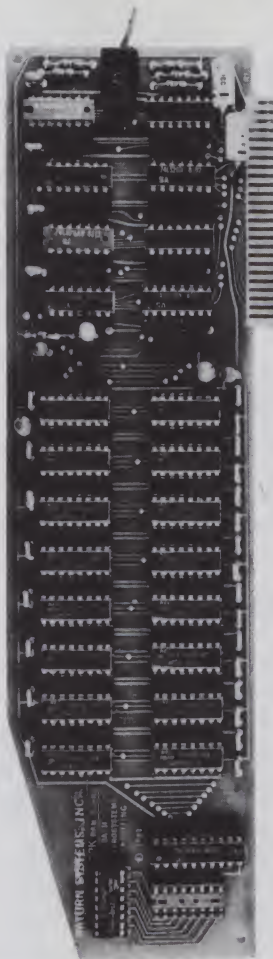
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Saturn Systems Expansion Board, available from Computer Data Services.

priced from \$599.95. The M-65/50 interface costs \$49.95. Reader Service number 486.

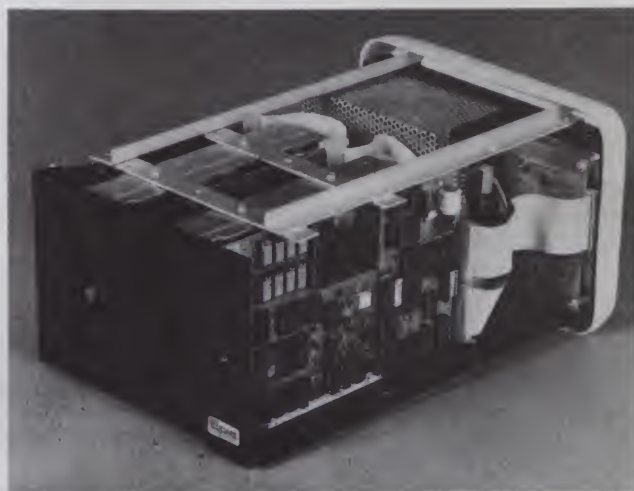
## Double Your Memory

The 32K byte RAM Expansion Board from Saturn Systems provides twice as much memory as existing RAM cards. It is compatible with Microsoft CP/M and Z-80 Softcard, lets you run Pascal, FORTRAN, Pilot and other languages available for the Apple II, and increases VisiCalc memory by an additional 9K. The Saturn board comes with software that will automatically relocate DOS into one of the two 16K banks on the board—giving you AppleSoft and Integer BASIC. DOS capability and 48K bytes with which to program on one board. Price is \$239.

Computer Data Services,  
PO Box 696, Route 122,  
Amherst, NH 03031. Reader  
Service number 484.

## A Compact Stand-Alone Computer

The Episode is a fully-contained Z-80A microcomputer that occupies about the same desk space as a legal document and is designed to interface with a wide variety of peripherals. The entire logic circuit, containing 64K-byte memory, dual serial I/O, Centronics-type parallel interface, floppy-disk controller and battery-powered calendar clock, occupies a single six-inch by eight-inch card. The Episode offers storage capaci-



The Episode fully-contained microcomputer from Epic Computer Corporation.



ties up to 1.6 megabytes on dual five-inch floppy-disk drives. Curly phone cord connections to the console and printer, fully internal diagnostic test circuitry and modem interface aid the Episode's expansion into network use. The computer interfaces with most CRT terminals and printers. Price is \$2550, including CP/M and Supervyz software.

Epic Computer Corporation, 9181 Chesapeake Drive, San Diego, CA 92123. Reader Service number 483.

### Auxiliary Processor Speeds Apples

The microSpeed Language System gives Apple users processing speeds up to 100 times faster than Applesoft BASIC. Developed from an extended version of Forth, the hardware/software package employs the Intel 8231A arithmetic processor with an interactive compiler to provide increased computer performance. The microSpeed system offers enhanced programming capabilities including print formatting, faster high-resolution plotting, turtle graphics and extended, high-speed mathematical functions. MicroSpeed II uses the 2 MHz version of the arithmetic processor, and microSpeed II+ uses the newer 4 MHz version. For a variety of numerical applications, microSpeed II users can expect a tenfold improvement in processing speed; microSpeed

II+ offers a speed improvement approaching a factor of 20. Both systems include the auxiliary processor card and user's manual. MicroSpeed II is \$495; microSpeed II+ is \$645.

Applied Analytics Incorporated, 8910 Brookridge Drive, Suite 700, Upper Marlboro, MD 20772. Reader Service number 488.

### Disposable Cleaning Disks

The Verbatim Datalife head cleaning kit removes up to 90 percent of debris contaminating magnetic recording heads used in computer and word processing systems. The kit consists of a durable, reusable Lexan jacket and presaturated, disposable cleaning disks. The cleaning disk is removed from its protective foil and polyethylene pouch, inserted into the Lexan jacket, and the whole assembly is put into the drive. The drive is turned on, and 60 seconds later the heads are clean. According to the manufacturer, competitive disks are made of PVC containing additives which, when exposed to the cleaning solution, are partially soluble and may contaminate the recording head, but Verbatim disks do not contain solvent-extractable plasticizing agents. Price for 10-pack of replacement disks is \$20. (A free kit consisting of the Lexan jacket and two cleaning disks is offered through January 1982 with purchase of the 10-pack.)



Real-time flight simulator of a Vertical Attitude Takeoff and Land (VATOL) aircraft using the microSpeed Language System. The simulator is currently in use by the U.S. Navy.



Verbatim's Datalife magnetic head cleaning kit.

Verbatim Corp., 323 Soquel Way, Sunnyvale, CA 94086. Reader Service number 482.

### Don't Bake Your Apple

The Apple Cooler is designed to provide your computer system with a professional appearance and lots of fresh air. The smoked plexiglass Apple Cooler replaces the Apple's cover and has enough room for a nine-inch monitor and two drives. A Rotron muffin fan prevents the Apple's core from overheating—which could make it do

some pretty strange things. Price is \$159.50.

Concepts & Systems/Research Center, 553 Lancaster, PO Box 4041, Jacksonville, FL 32201. Reader Service number 492.

### Gold Edge Plug For Model I

The Gold Plug 80 kit eliminates disk errors that occur because of oxidation of the tin/lead surface of the TRS-80 Model I expansion ports. It is a gold-plated card edge plug that is soldered directly to the existing tin/lead-plated card



The Apple Cooler from Concepts & Systems replaces the Apple's cover to provide forced cooling.



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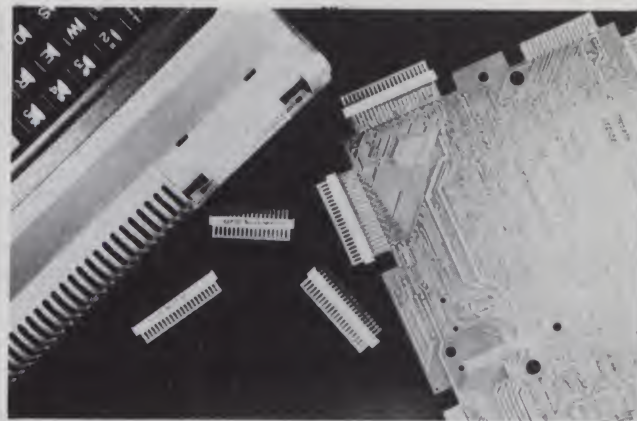
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- **IF...NEXT SENTENCE...ELSE...**
- **NEXT SENTENCE AND/OR**
- **<=> NOT.**
- **GO TO...DEPENDING ON.**
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Gold Plug 80 kit from E.A.P.

edge plug on the Model I CPU and expansion interface ports. Compatibility remains the same. Installation requires disassembly of the keyboard/CPU and/or the expansion interface. The doors will not fit after installation of the Gold Plug 80. A full set for all six ports costs \$54.95.

E.A.P., PO Box 14, Keller, TX 76248. Reader Service number 490.

tage of the Apple's ability to handle up to four game controllers. The device plugged into one socket is treated as game controllers 0 and 1. The other device is treated as numbers 2 and 3. In either mode the Paddle-Adapple can be configured to exchange the x and y axes, reassign push button numbers and make other modifications. Programmers can now write games for four players, each with a paddle and push button. The Paddle-Adapple costs \$31.45.

Southern California Research Group, PO Box 2231K, Goleta, CA 93118. Reader Service number 494.

## I/O Expansion Adapter

The Paddle-Adapple plugs into the game I/O, and is designed to operate in one of two modes. In the first; it lets you select either of two devices plugged into your Apple, such as a set of paddles or a joystick. It is no longer necessary to open your Apple to remove one device and plug in the other. In the second mode, the Paddle-Adapple takes advan-

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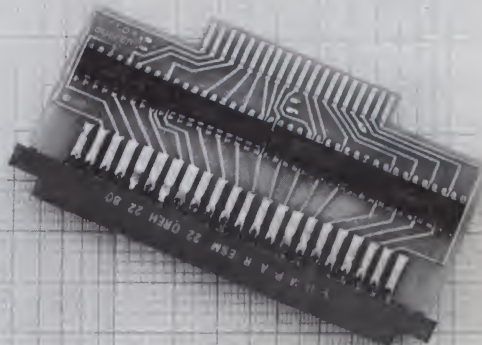
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The Color Buffer from TBH.





The Commsoft Codem, a universal CW interface for microcomputers.

the system bus through the game slot cartridge; it terminates in the standard 22/44 card edge connector, providing the hobbyist or experimenter with easy access to fully buffered address, data and control lines. The Color Buffer also serves as a building block, letting the user plug in a variety of other peripherals. Price is \$59.95 (\$69.95 Canadian).

TBH Canada, 67-3691 Albion Road, Ottawa, Ontario, Canada K1T 1P2. Reader Service number 485.

### Interface for Radio Amateurs

The Codem provides an easy way to get Morse code software on the air. The Codem doubles as a code practice oscillator and CW regenerator; it converts received CW audio to RS-232 or TTL signal levels, and RS-232 or TTL signal levels to transmitter keying. A sharp 800 Hz bandpass filter, AM detector and low pass filter are designed into the Codem to pro-

vide noise and QRM rejection. CW can be monitored using an internal two-inch speaker or with an external high-impedance earphone. Front panel sensitivity, tone and volume controls are provided. The Codem requires an external 9 V dc power supply. The price is \$129.95. The 9 V dc power supply is \$9.95.

Commssoft, 665 Maybell Ave., Palo Alto, CA 94306. Reader Service number 493.

### VIC Graphics

Commodore Business Machines, Inc., Computer Systems Division, 681 Moore Road, King of Prussia, PA 19406, has announced a dot matrix printer for its VIC 20 microcomputer. The VIC 1515 can print any of the alphabetic, numeric and graphics symbols common to the VIC 20, at a speed of 30 characters per second. Special enhancements also allow the VIC 1515 to print extra-wide and reversed (negative) characters. The printer is priced at \$395. Reader Service number 487.



The VIC 1515 dot matrix printer from Commodore.

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Software packages from Passport Designs expand the Sound-chaser's musical talents.

## Two New Music Programs

The Soundchaser polyphonic synthesizer now performs as a music transcriber and a music educator, using new software packages from Passport Designs, Inc., 785 Main St., Suite E, Half Moon Bay, CA 94019.

The Notewriter program turns Soundchaser into a real-time music transcriber. The notes you play on the music keyboard will be written on the screen in standard music notation. Editing features facilitate quick changes in tempo, key signature, phrasing, thematic material and other aspects of music notation. The score can be printed out with a graphics printer.

Musictutor software turns Soundchaser into an educational tool. Programmed learning courses in ear training, music theory and harmony can be used to develop skills and basic musicianship. Price for Notewriter is \$100; Musictutor costs \$150. Reader Service number 474.

## Statistics for the TRS-80

Statistical Package for Microcomputers (SPM) is available for the TRS-80 Model I or III from Bruce P. Douglass, 20 Willow, Vermillion, SD 57069. SPM consists of five programs that perform descriptive statistics, analysis of variance and single- and multiple-variable regression. It features analysis of variance with unequal sample sizes, exceptional flexibility in formatting post hoc and planned comparison analysis and computation of percentile ranks of F ratio statistics.

All the programs allow for easy input, output and editing of data. SPM is supplied on cassette for \$41.95. Reader Service number 467.

## Shadow Hawk

A new game with triple-axis, high-resolution, three-dimensional color graphics is offered by Horizon Simulations, 107 E. Main, Medford,

OR. The Galactic Empire has conquered the entire solar system; imperial merchant ships carrying essential materials link the planets and their moons; and the Empire's combat ships patrol space, in which deadly satellite battle stations are suspended. The vanquished Confederation of Free Space, however, has one last weapon: Shadow Hawk I, the swiftest little warcraft in the solar system. Its valiant commander is the lone player of the game, and his challenge is to engage the enemy against insurmountable odds. End game success is measured by progress achieved before defeat. Shadow Hawk is available on disk for Apple II or Atari 800, 48K, with disk drive and joysticks. Price is \$49.95. Reader Service number 468.

## Electronic Worksheet Program

Supercalc prepares an electronic ledger on the display of the Z-89 microcomputer and lets the user enter text or numeric information and perform calculations. The most common uses of electronic worksheet programs are for budgeting, balance sheets, financial modeling, forecasting of sales/inventory/production and summary reports. Supercalc can be used with other programs which run under the CP/M operating system, including word processing or telephone communications software. It can be used on any microcomputer with CP/M, but modifications to Supercalc have been made

that take advantage of special function keys on 48K-byte Zenith Data Systems or Heathkit microcomputers. A help command provides access to explanations without referring to a manual. Problems requiring changes in calculations (such as price breaks based on sales volume) are handled with conditional formulas. Changes to important information can be prevented by using a protect command. Supercalc is available on five- or eight-inch disks. Price is \$295.

Zenith Data Systems, 1000 Milwaukee Ave., Glenview IL 60025. Reader Service number 470.

## Hi-Res Dump Routines

Grafpak is a family of high-resolution graphics dump programs for use with the Apple II, or with the Apple III in Apple II emulator mode. Grafpak offers a wide range of scale factors for dumping hi-res pictures, limited only by your printer's dot density and carriage width. Every Grafpak will dump either hi-res page horizontally or vertically, and will dump both pages buttled vertically in a perfectly registered panorama. Grafpak includes Composer, a utility for positioning graphic images, cropping image edges, white/black inversion and image framing. Composer will also compress hi-res pictures to minimize disk space, and expand them for conventional display. Grafpaks are available for Epson Grafrax, priced



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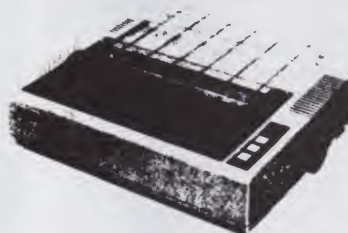
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The most revolutionary thing about the Epson MX-80 isn't the bidirectional printing or the logical seeking function. It isn't even the disposable print head - although that's pretty revolutionary. The most revolutionary thing about the MX-80 is the price.

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MICRO MERCHANTS Division Comtek Electronics, Inc.



### I(terchange)

I(terchange) is a general purpose file maintenance program for use with the CP/M™ operating system. Since it is a single program written in optimized Z-80™ code, it is much faster and easier to use than other file maintenance programs. Features include: DIR as usual plus listing all files *excluding* those with a specified character(s), ERA as usual plus *exclusive* erases. Also, a "Q" switch can be used to query each erase, a "W" allows erases of R/O files without query (normally you are queried), and an "R" switch if system files are to be included, LIST permits listings and uses TAB, WIDTH, LINES and WRAP for control, COPY as usual plus *exclusive* copies and supports the "Q", "W" and "R" switches plus an "E" switch for query on existing files, STAT with ambiguous, unambiguous and exclusive listings and produces an alphabetized listing with file length, total directory entries and space used and unused, START-END allows for copying contiguous data files, and RENAME as usual plus ambiguous renames. Other commands include: QT, DATE, TIME and SETIT (for the QT clock board) plus CLEAR, RESET, HELP and TYPE. Disk copies can even be continued after a disk full condition by simply inserting a new disk. All of this in one program without ever having to leave I(terchange) and wait until you see the speed improvement . . .

The price for I(terchange) is \$59.95 and the manual is available for \$10.00 (credited towards purchase). I(terchange) is recommended for 32K or larger systems using CP/M™ 2.0 or later. It will not run on an 8080 CPU and only User 0 is supported.

All programs are available on 8" SD or North Star 5 1/4" disk. Microstat is available for North Star Basic, Microsoft's Basic-80 (Rel. 5.0 or later) or compiler Systems CBasic2. Please specify when ordering.

CP/M is a registered trademark of Digital Research.

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### COMPUTER INTERFACES & PERIPHERALS

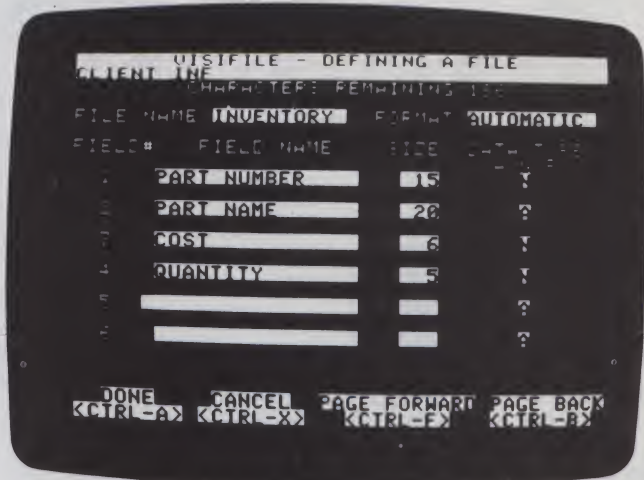
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This "black box" controller/formatter is designed as a standalone interface between industry-standard NRZ1 (800 BPI) and PE (1600 BPI) tape drives and a parallel or RS-232 serial port of an 8-bit ASCII computer. Serial interface emulates a terminal vis-a-vis your system software; parallel interface emulates a reader/punch and responds to CPM-style PIP commands from your computer. Tape speeds 12.5, 25 and 37.5 ips. Interface is microprocessor-controlled, includes power supply and 4K or 16K buffer memory. Prices and details available upon request.

- **POS-100 NRZ1 TAPE DRIVE CONTROLLER/FORMATTER** — Now your micro can read and write IBM/ANSI compatible NRZ1 format 9-track magnetic tapes. The POS-100 consists of S-100 bus card, 6' ribbon cable, tape drive controller card, cable to Pertec-Standard NRZ1 Tape drive, plus documentation and Z-80 or 8080 software (specify). Power is derived from tape drive and S-100 bus. Ship Wt.: 10 lbs. Suggested Retail Price . . . . . \$995.00
- **POS DAISY-WHEEL PRINTER INTERFACE for TRS-80** — Will drive Diablo HyType I, HyType II, and Qume Q and Sprint 3 printers. Includes 1K user-available memory for custom print routines (such as graphics, bidirectional printing, etc.). Programmed to respond to print commands from BASIC ELECTRIC PENCIL™ and SCRIPSIT™ software. Draws its power from printer. Ship wt.: 5 lbs. Price . . . . . \$250.00  
Cables, each (Specify HyType I, HyType II, or Qume) . . . . . \$ 25.00
- **POS ASCII INTERFACE for IBM I/O SELECTRIC** — This Centronics-style parallel printer interface will drive an IBM Model 731 or 735 I/O typewriter (EBCD and Correspondence codes). No software needed. Features on-board EPROM which holds up to 8 ASCII-to-IBM code tables for different type spheres. Closed-loop operation runs at maximum printer speed; stops and starts on a single character without loss of data. Requires +12VDC and +5VDC power source. Ship wt.: 5 lbs. Price . . . . . \$249.95  
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- **GTE Model 560 ASCII SELECTRIC I/O Terminal** — With RS-232 Serial Interface and digital cassette deck for use as memory typewriter. Ship wt.: 100 lbs. Price, tested and adjusted . . . . . \$1,195.00
- **POS ASCII IBM SELECTRIC PRINTER** — 15" Selectric from GTE terminal cleaned and adjusted with POS Centronics-style ASCII printer interface, UC/LC, carbon and fabric ribbons. Compatible with TRS-80, Apple, SOL and other CPU parallel printer ports. Ship wt.: 75 lbs. Price . . . . . \$895.00

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at \$34.95; for Anadex Grafix-Plus at \$39.95; for Integral Data Dot Plot IDS 440-445 at \$29.95 and IDS 460-560 at \$39.95; and for NEC PC-8023A-C at \$34.95.

SmartWare, 2281 Cobble Stone Court, Dayton, OH 45431. Reader Service number 473.

### Electronic Filing

File management on a personal computer is fast and simple with VisiFile from Personal Software, 1330 Bordeaux Drive, Sunnyvale, CA 94086. The program stores, sorts and prints inventory, client lists and records, sales information, medical records and other word or numerical data. The VisiFile FlexFormat feature lets the user change, rearrange and add unforeseen information or combine records into new files. For example, the change from a five-digit to nine-digit zip code could be made without retyping all the data. VisiFile communicates with other Visi software for efficient handling of information. Price is \$250. Reader Service number 466.

### Legal Dictionary

SP-Law Dictionary is a Spellguard-compatible program that checks the spelling in legal documents. It has a 15,000-word lexicon of legal terms and reference words, including Latin phrases frequently used in law offices. Another 20,000 commonly used English words come with the basic Spellguard program. These 35,000 words re-

quire 80K bytes of disk storage. With the SP-Law Dictionary and Spellguard, users can proofread over 15,000 words in one minute on a double-density floppy system. SP-Law Dictionary runs on a microcomputer with a minimum of 32K bytes of memory, at least one floppy disk drive and the CP/M operating system. It requires Spellguard and a word processing program that uses the same configuration. SP-Law Dictionary is available on a five-inch or eight-inch disk for \$125.

Innovative Software Applications, 260 Sheridan Ave., Suite 300, Palo Alto, CA 94306. Reader Service number 464.

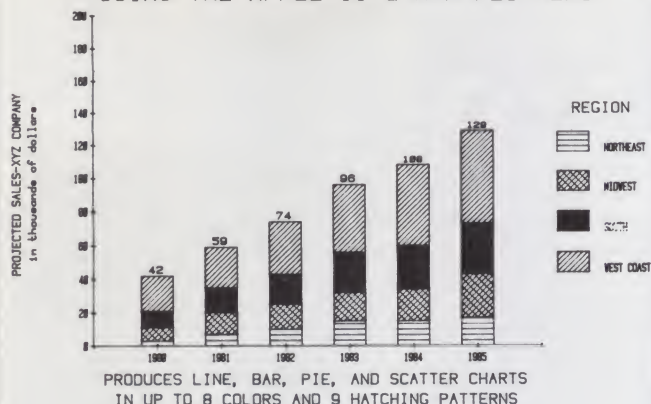
### Business Graphics for the Apple

Software Resources, Inc., 186 Alewife Brook Parkway, Suite 310, Cambridge, MA 02138, announces Trend-Spotter, a business graphics and forecasting analysis package. Trend-Spotter will generate color graphics displays, calculate and display trend lines, perform mathematical and statistical computations, print graphic and tabular data, and edit and update data files. Trend-Spotter can generate and read VisiCalc-compatible files. The system requires an Apple II+ with 48K bytes of memory, disk drive and monitor. A second disk drive and printer are useful. Price is \$175.

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Decision Resources, 44 White Birch Road, Weston, CT 06883. Reader Service number 472.

### BASIC-to-TI 58/59 Translator

You can create keystroke programs for programmable calculators with a new computer software product from Singular Systems, 810 Stratford, Sidney, OH 45365. The BASIC-to-TI 58/59 Cross Compiler automatically translates BASIC programs into keystroke programs for Texas Instruments TI 58 and TI 59 calculators. The user can conveniently develop, refine and test his programs in BASIC,

taking advantage of the high-level language's editing and debugging features. The programs can then be compiled on the same machine into an equivalent keystroke program for the calculator. Extended features of the Cross Compiler include keystroke optimization, complete keystroke program listing, listing of BASIC variables used and their corresponding calculator memory registers, listing of calculator labels used, and recognition of standard and nonstandard BASIC commands and functions. Price is \$65 for BASIC program listing, user's manual and documentation. The BASIC source program is also available in card image format on 9-track tape for an additional \$35. Reader Service number 480.

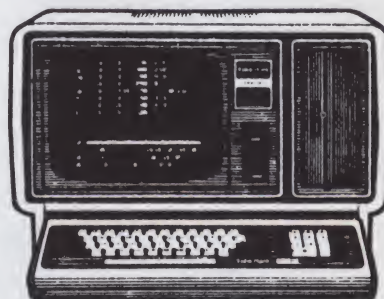
### Star Warrior for Atari Computer

Star Warrior is a fast-action science fiction adventure for the Atari 800. The Star Warrior player is an interplanetary avenger who must single-handedly oppose an entire planetary force of storm troopers. The avenger can walk, jump—or even fly—over swamps, forests and mountains. S/he is armed with sophisticated electronic direction-finding equipment, decoys to fool the enemy, nuclear missiles, blaster and powergun. In addition to several suits of armor, the player can also choose either of two scenarios. In the first, the enemy must be directed away from the main attack, while the

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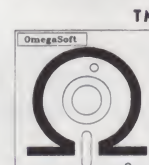
Now available for most 6809 operating systems is a compact single-pass compiler that quickly translates Pascal into optimized assembly language code. OmegaSoft Pascal is an ideal way to increase your programmers' productivity in all phases of program generation and maintenance.

The accepted syntax is based on the proposed ISO standard with extensions designed to interface to the real world. Byte wide variables can be manipulated to easily access I/O devices and complete support is provided allowing user defined interfaces to be used with the standard Pascal procedures. Dynamic length strings, long integers, and random disk files facilitate development of sophisticated applications programs for industry and business.

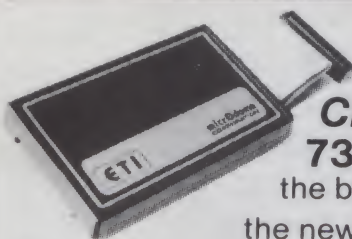
An interactive symbolic debugger is included to allow you to quickly execute your program. The debugger allows setting breakpoints at the start of Pascal statements, examining and changing variables, and to trace through one statement at a time. Utilities are provided to interactively create the control files used to automatically compile, assemble, and link the Pascal program to produce a totally position independent, reentrant, and removable object module.

OmegaSoft currently supports five of the most popular 6809 operating systems and OEM licenses can be arranged. Single unit domestic list price (\$81) for the compiler package is \$425 with quantity and dealer discounts available. For a data sheet and ordering information write or call:

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player destroys as many military installations as possible in a predetermined time limit. In the second scenario, the player must track down and destroy the tyrannical military governor and staff. But the governor is always on the move, so the player never knows where to look. Star Warrior has 19 command options and five levels of skill, with sound effects and graphics display. Price is \$39.95.

Automated Simulations, PO Box 4247, Mountain View, CA 94040. Reader Service number 476.

### New 6809 Cross Software

A relocatable cross assembler, relocatable cross compiler and cross linker for the 6809 microprocessor are available from Wintek Corp., 1801 South St., Lafayette, IN 47904. The assembler supports nested macros and conditional assembly. The PL/W compiler supports a high-level language styled after IBM's PL/1. PL/W is a block structured language which supports control structures required for structured programming. Also available is a floating point/scientific package for easy access to floating-point arithmetic and scientific functions. All programs are written in ANSI standard FORTRAN (X3.9-1966) for 16-bit or larger machines. Prices are approximately \$1000 per program or \$3400 for the complete package. Reader Service number 475.

### Fast and Flexible Mailing Program

The Mail Mate mail-merge package operates with Magic Window word processing system or as a stand-alone mailing/phone list program. To merge letters produced from Magic Window, the user produces a soft copy in the printer subsystem; Mail Mate then accesses the soft copy and merges it with the addresses and names selected from the user's address list. The highlights of the system are an extremely quick sort, string search on names of uncertain spelling, 10 selection fields (36 acceptable alphanumeric codes per field) and flexible specification of selection codes for printing and logical AND specification between selection fields. It runs on an Apple II with at least one disk drive. Price is \$68 (\$85 in Canada).

Evolution Software, Inc., 1632 Bathurst St., Toronto, Ontario, Canada M5P 3J5. Reader Service number 471.

### Stereo Images

The Stereo Generator runs on a 48K Apple II+ and lets the user define, manipulate and view three-dimensional objects. The easy-to-use program is of special interest to students of coordinate systems, analytic geometry, drafting, physics and graphic arts. The user defines arbitrary three-dimensional objects comprising up to 65 points in space connected by



Wintek Corp. has a cross assembler, cross compiler and cross linker for 16-bit machines.



up to 170 line segments. The program then generates stereoscopic image pairs on the second high-resolution screen, so the object is perceived in three dimensions. The game paddles rotate the object 360 degrees about each of two body axes. Generation time varies from one to 15 seconds, depending upon complexity of the object. Subroutines allow control of display modes, scale factors, depth perception, object definition, image superimposition, orientation sequences, disk control and optional printing. The program is available on DOS 3.2 or 3.3 disks. Program, stereo viewer and complete documentation cost \$36.95.

R-Alpha Software, Box 3332, Crofton, MD 21114. Reader Service number 478.

### CP/M Data Comm

Intercom communications software for the CP/M operating system is available for the TRS-80 Model II, Cromemco, Zenith, Ohio Scientific and Apple II computers. The package, written in 8080 code, is designed for interactive communications and verified quantity file transfers (including object files) using several standard protocols. Other features include four automatic sign-on routines, four user-definable routines, batch mode for unattended operation, and CP/M system-level commands including directory with disk space utilization. Price is \$75.

End of File, Inc., 3140 E. Shadowlawn Ave., Atlanta, GA 30305. Reader Service number 479.

### Color Computer Game

Mark Data Products, 23802 Barquilla, Mission Viejo, CA 92691, introduces Color Berserk, a new high-resolution graphics game for 16K Radio Shack Color Computers. Color Berserk resembles the popular arcade game, with dynamite sound effects and super joy stick action. Angry robots and Evil Orville combine to provide hours of challenging play for one or two combatants. Color Berserk is available on cassette for

\$24.95. Reader Service number 481.

### Apple Business Planning

The Depreciation Planner runs on an Apple microcomputer and keeps track of depreciable assets for accounting and tax planning purposes. It incorporates earlier depreciation methods (for assets purchased before January 1981), and the new depreciation methods. It is faster than manual record keeping, and reduces paperwork and chance of error. The user determines cost, salvage amount, useful life and special restrictions or conditions pertaining to the asset and depreciation method. Once these figures are entered, Depreciation Planner automatically keeps track of each asset, calculates current month depreciation, year-to-date and life-to-date amounts, and prints lists of assets according to the user's requirements. The Depreciation Planner can work independently, or it will interface with The Controller or The Business Bookkeeping System and automatically post depreciation amounts to the General Ledger and update current amounts for each asset. Price is \$395.

Dakin5 Corporation, 7475 Dakin St., Fourth Floor, Denver, CO 80221. Reader Service number 477.

### Overlay Compiler

An overlay structure is now possible under an extension to the Comstar compiler for North Star BASIC. An overlay differs from program chaining in that a root program segment and selected program variables can survive intact as a new program segment is introduced. An overlay structure allows very large programs to be executed and is also suitable for a menu-driven system of programs. The overlay extension is available for \$75 to registered owners of the Comstar compiler and includes a CP/M overlay capability for those with the Comstar-CP/M interface.

Allen Ashley, 395 Sierra Madre Villa, Pasadena, CA 91107. Reader Service number 469.

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# Letter-Perfect Mail Program

Muse's  
Form Letter  
For Apple II

## Form Letter Module

I recently received an invitation from a publisher to write a book. This was quite flattering, until I realized he had merely typed my name and address on a printed form letter which was general enough to apply to all writers on his mailing list. His list is evidently composed of all contributors to *Microcomputing* and other computer magazines.

How much more effective his letter would have been if it had mentioned the name of my article and the name of the magazine in which it had appeared! At 20 cents a clatter for first-class postage, form letters need all the help they can get.

Muse Software, Inc. (330 North Charles St., Baltimore, MD 21201), has released a program for the Apple II that allows its user to "personalize" a form letter to the extent that the addressee *has* to believe the sender sat down and wrote a letter just to him.

This program, called the Form Letter Module, runs with Super-Text II (also by Muse), merging text with variables to produce a highly personal letter. Add to it Muse's Address Book program, and you have a fully automatic system for writing personal messages to everyone on your list. The programs require 48K bytes of RAM and at least one disk.

Here's how the package works:

First, you create a mailing list with Ad-

The Form Letter Module can extract up to 18 variables from these eight entries. For example, NAME=DR. PETER P. PAINE DDS. can be used in the Form Letter Module as:

\$Name	Dr. Peter P. Paine Dds.
\$Title	Dr.
\$Fname	Peter
\$Lname	Paine
\$SUFFIX	DDS
\$Bname	Peter P. Paine
\$Nickname	Pete (when used with NICKNAMES file).

The addressee has to believe  
the sender sat down  
and wrote a letter just to him.

dress Book. The list may have as many as 700 addresses on one disk, each address containing eight variables: name, company, street, city, state, zip, phone and category.

Note that capitalization in text is controlled by the way the variable name is capitalized.

If the publisher had used the Form Letter Module in his letter to me, he may have taken some liberties with Address Book and entered my address as shown in Sample 1, or someone else's as in Sample 2.

Then, he would go to Super-Text II and write a letter something like that shown in Sample 3. The letters as printed out would be highly personal as shown in Samples 4 and 5, and yet would still have the timesaving attributes of an automated form letter.

Note that I have taken some liberties with the Address Book format, making the suffix of the addressee's name equal the name of the magazine in which his article appeared, and the phone number the issue date. You could achieve the same purpose in a number of ways, and this is not necessarily the best one. The point is, the programs are versatile and forgiving.

Note also the IF statement in the body of the letter. This function (used in its simplest form in the example) opens up a whole world of possibilities. The letter could contain a zillion IF statements, with a different element of text to be

NAME	MR. DAVID C. GOODFELLOW MICROCOMPUTING
COMPANY	SO I BOUGHT THIS COMPUTER
STREET	P.O. BOX 66834
STATE	WASHINGTON
ZIP	98166
PHONE	NOVEMBER 1980
CATEGORY	WR

Sample 1.

NAME	MS. JULIE P. WRITER BRAND-X-MAG.
COMPANY	MICROPROCESSOR MADNESS
STREET	6618 3RD E.
CITY	ANYTOWN
STATE	WASHINGTON
ZIP	98111
PHONE	FEBRUARY 1981
CATEGORY	WR

Sample 2.



\$Date

\$Title \$Bname  
\$Street  
\$City, \$STATE-CD \$ZIP

Dear \$Title \$Lname:

We noticed your fine article, "\$Company," in the \$Phone issue of \$SUFFIX. We'd very much like you to consider the possibility of writing a book for us on that subject or another computer subject in which you have expertise.

.IF \$TITLE = "MS."  
Women are still considered something of a rarity in this highly technical field, so we believe your contribution would be well received.  
.ON

Etc., etc., etc.....

Sincerely,

John P. Publisher

\$Title \$Bname  
\$Street  
\$City, \$STATE-CD \$ZIP

*Sample 3. Form letter as originally typed, with embedded commands. The last three lines are preceded by a STOP code and a formatting command, which are invisible in this printout. These lines address the envelope. When running continuous form letterhead, omit these lines and print the addresses separately.*

April 3, 1981

Mr. David C. Goodfellow  
P.O. Box 66834  
Seattle, WA 98166

Dear Mr. Goodfellow:

We noticed your fine article, "So I Bought This Computer," in the November 1980 issue of MICROCOMPUTING. We'd very much like you to consider the possibility of writing a book for us on that subject or another computer subject in which you have expertise.

Etc., etc., etc.....

Sincerely,

John P. Publisher

*Sample 4. Sample letter from first record on Address Book. Note the article title, magazine name and date of issue extracted from the address file and merged with the text.*

plugged in for each. The result would be that a single form letter would have an entirely different content for different addressees.

#### Details

If you do not wish to use Address Book with the Form Letter Module, the latter

program will prompt you for names and addresses. This works quite well, but I for one would rather use Address Book.

When printing out letters from your mailing list, you may search for any of the variables, and print letters only to those which satisfy your search criteria. This is good for limiting your letters to a

# Call For Manuscripts

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- What programs have you written to meet your specific needs? Perhaps another businessman can use them, too. Even if he can't, your program may serve as a springboard for other ideas.

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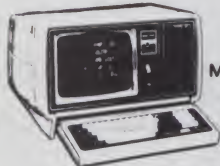
Kilobaud Microcomputing  
Pine St.  
Peterborough, NH 03458



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April 3, 1981

Ms. Julie P. Writer  
66618 3rd E.  
Anytown, WA 98111

Dear Ms. Writer:

We noticed your fine article, "Microcomputer Madness," in the February 1981 issue of BRAND-X-MAG. We'd very much like you to consider the possibility of writing a book for us on that subject or another computer subject in which you have expertise.

Women are still considered something of a rarity in this highly technical field, so we believe your contribution would be well received.

Etc., etc., etc.....

Sincerely,

John P. Publisher

Sample 5. Sample letter from second record on Address Book. Note that \$TITLE satisfied the IF statement, so the second paragraph was printed.

certain area, profession, etc.

The programs are so easy to use and well-documented that the beginner can be using them effectively within an hour or so. As he uses them, he will find their capabilities limited only by his own imagination.

The programs could just as easily be applied to existing customers, with the same basic letter congratulating some on their prompt payment, reminding others that a payment is overdue and warning still others that their credit rating is in jeopardy.

The Form Letter Module requires Super-Text II, and works best when Address Book is added to the package. The

whole package adds up to about \$300—\$150 for Super-Text II, \$100 for Form Letter Module and \$49.95 for Address Book.

## Conclusion

On a scale of one to ten, I would rate the whole package at about 18. If a review should expose deficiencies in the subject program, this review is sadly lacking. The truth is, I could find no problems of any consequence—only a software package that I, in my business, would not be without.

David C. Goodfellow  
Seattle, WA

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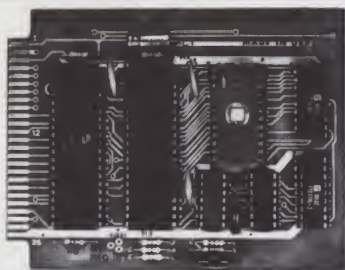
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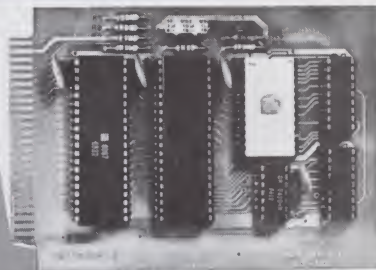


Z-80 MPU, Z-80 PIO, 2716 EPROM 2114 RAM single board computer. Single 5 volt power supply at 300 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 2MHz clock.

Complete documentation. I/O lines use 50 pin edge connector data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-280 Assm.	<b>\$129.95</b>
80-280 Kit	<b>\$119.95</b>
80-280 Bare Board	<b>\$ 19.95</b>

## 6502 MICROCOMPUTER

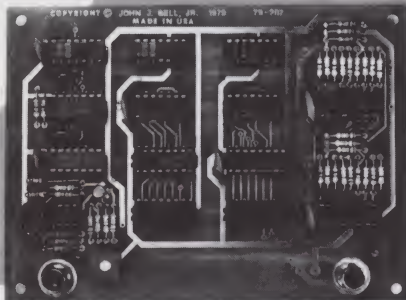


6502 MPU, 6522 VIA, 2716 EPROM 2114 RAM single board computer. Single 5 volt power supply at 400 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 1 MHz clock.

Complete documentation. I/O lines use 50 pin edge connector data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

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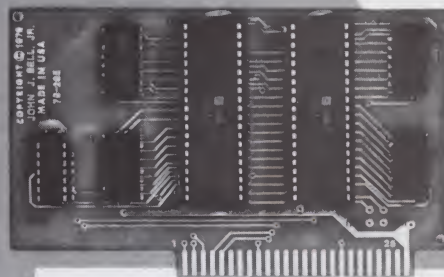
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# Three Books for Beginners

## 6502 Software Design

## From ENIAC to UNIVAC

### Small Computers

Fred D'Ignazio

Franklin Watts, 1981, 146 pp.

Book publishers are responding to the mushrooming use of microcomputers in classrooms with a flood of introductory books for school kids. *Small Computers* is the author's third effort in explaining micros to students.

D'Ignazio offers almost no information on the developmental history of computers, preferring to start with the present status and proceed to future uses and problems. His view includes single-purpose devices as well as user-programmable ones. In fact, by choosing a digital watch for illustrating the elements of programming, he is able to limit the discussion to programming only, without getting into peripheral concerns.

The virtues of doing one's own programming are particularly stressed. The author introduces the concept of building models of real-world situations, and declares that in mastering programming skills, one has the glue with which to construct any such model on a computer.

The most impressive part of the book deals with computers and programming of the future. The fascinating and tantalizing truth is that this future is almost upon us. Bubble memories, the Josephson computer and sophisticated voice-recognition/synthesizing capabilities are all covered briefly, but I found myself wanting more than the six pages devoted to Xerox Corporation's Smalltalk language and programming system. This *system's* computer, Dynabook, is expected to shrink to the size of a notebook by the mid-1980s. To this reader, schooled in the limitations of BASIC, the capabilities of Smalltalk are mindboggling, and yet any visitor to Xerox's Palo Alto facility can experiment with it today.

Rather than paint a totally rosy picture of our computerized future, D'Ignazio also shows us the darker side of what that future might bring. Sections on computer sabotage, information burglary and

the possibility of a truly Orwellian 1984 warn that we must proceed with extreme caution: we must not accept this brave new world blindly.

The appendices on books and magazines are very up-to-date, and although not exhaustive, they do list only those items which are easily accessible. An excellent 12 page glossary is also included.

Many current offerings in this field are written by generalist free-lancers. Fred D'Ignazio, however, is a programmer/analyst and a Ph.D. candidate in computer science, and his book shows it. Ostensibly it is aimed at a high school audience, but there is nothing about the language, and very little about the illustrations, that would confine its use to that age level. The curious adult layman might well find *Small Computers* the best books for beginners in this often bewildering field.

### Computers in Your Life

Melvin Berger

Thomas Y. Crowell, 1981

117 pp., \$8.79

*Computers in Your Life* is aimed at the junior high school student. Berger is not a computer expert, but has published over 60 books on a variety of subjects for young readers, many of them to considerable critical acclaim.

He begins with a short grabber chapter, in which several urgent situations are resolved by computers. Then he introduces the computer itself, covering briefly but adequately its first three generations; i.e., vacuum tube, transistor and modern large-scale integrated circuits. Each of the five parts of a computer—input, storage, control, processor and output—is described.

The remaining chapters are devoted to individual areas of computer applications. They cover medicine, communications, transportation, business and industry, education, games, law enforcement and government with the author skillfully shifting from narrative to dra-

matic vignette to the "what-if" technique.

There are over three-dozen clear photographs. Each has its own descriptive sentence, and each is placed adjacent to the text it is intended to support. The illustrations of core memory and magnetic bubble memory are especially helpful.

There's also an extensive index and bibliography. However, a book with only 111 pages of text doesn't need three pages of index; the table of contents is adequate. The bibliography lists seven books, and although I cannot quarrel with the selection, several seem too advanced to recommend to a junior high school student.

The reservations above are minor. The book is a fine introduction to the broad field of computers and their current applications. If you've got a youngster whose interest in computers you'd like to nurture, give him or her a copy of *Computers in Your Life*.

### Exploring with Computers

Gary Bitter

Julian Messner, 1981

Hardcover, 64 pp.

*Exploring with Computers* is aimed at fifth, sixth and seventh graders, who will appreciate the author's straightforward, unpatronizing tone. The ten-page, thoughtfully illustrated beginning section on the history of computers dutifully mentions the key figures: Pascal, Morland, Leibniz, Babbage, Jacquard, Hollerith and several giants of 20th century computerdom.

In describing how a computer works, Bitter correlates the brain's operations with those of the computer through the stages of a single problem. This lends a framework to the subsequent descriptions of input, central processing unit, arithmetic unit, memory and output. On their first appearance in the text, key words are italicized. This is a nice feature, but I would have liked a glossary of those terms—there is none. The book continues with brief sections on hard-





ware and software, computer types, computer uses and misuses, careers and a look into the near future.

At this point Bitter could have switched off his typewriter and had a passable, although rather short, book to send to his publisher. Instead he pushes on, improving the effort immeasurably with the addition of a 15-page chapter "Computer-Related Activities for You." He shows how and why to write a flowchart, with an example first from the reader's own experiences, and then with a practical problem—programming a robot through a prescribed set of movements. Another exercise presents a simple BASIC program, whose elements are explained with elegant brevity.

There's more: I'd never have the audacity to try to explain to a ten-year-old how to read the holes in an IBM card, let alone actually hope to succeed at it. Bitter does this neatly in only five pages.

My complaints are both few and minor. The term debug is used without explanation—add that to the new glossary in the second edition, please. My last complaint refers to one of the many excellent photographs in the book. The photo in question is of the keyboard unit of a TRS-80 Model I, with the power supply visible behind it. The caption reads, "This is a microcomputer, controlled by the CPU behind the keyboard." This caption is at best misleading.

By now hundreds of thousands of elementary students are using computers in school, but little reading is available for them. We could use many more books that are as good as *Exploring with Computers*.

**Dennis C. Cullinan**  
East Lansing MI

### 6502 Software Design

Leo J. Scanlon  
H.W. Sams Co., 1980  
Softbound, 296 pp., \$12.95

In *6502 Software Design*, Scanlon has

done an excellent job of presenting topics of interest to the programmer working in machine language. He begins the book with a brief history of the development of the 6502 microprocessor and how this design history affected the processor's architecture. Chapters two and three provide an overview of the 6502 instruction set, addressing modes and use of subroutines. Chapter three includes an extensive section on developing software time-delay routines.

The remaining chapters of the book cover, in order, lists and look-up tables, mathematical routines, number base conversions, interrupts and resets, general purpose input/output devices and techniques. Two appendices cover the ASCII character set and a summary of the 6502 instruction set.

Most of the chapters are excellent, with each example and explanation building on material presented previously and setting the stage for information to follow.

This building-block approach is both enjoyable and understandable. Scanlon doesn't cover everything about software design, but he does equip the reader to try more complex routines than are presented in the book.

I do have some complaints about *6502 Software Design*. First, Scanlon is an employee of Rockwell International and has chosen the AIM 65 microcomputer as the system to present example software for. This is a minor inconvenience to all of us who must convert keyboard or display routines for other systems. This information could have been included with the examples.

Second, the chapter on the 6520 PIA and 6522 VIA devices was not as clear and easy to follow as the rest of the book. In fact, I felt it was harder to follow than much of the information published elsewhere on these useful interface chips.

On the whole, this book is a valuable addition to your library whether you own an Apple or a KIM, especially if you are just getting into machine-language programming.

**Thomas Franks**  
Wadsworth, OH

### From ENIAC to UNIVAC: An Appraisal of the Eckert-Mauchly Computers

Nancy Stern  
Digital Press  
Hardcover, 286 pp., \$25.

Don't let the title fool you. *From ENIAC to UNIVAC* is an interesting, informative and well-written account of the now-famous mainframes developed by J. Presper Eckert and John W. Mauchly in the 40s and 50s. It analyzes the personal, scientific and social dynamics that led to these monstrous progenitors, and explains why you're not reading *Adding Machine* magazine right now.

While the theories that eventually laid

the groundwork for our first computers had been kicking around for a number of years, it took a combination of factors before scientists and engineers actually got around to building one. First, and perhaps foremost, was World War II. As Stern says in her conclusions, "the major factors affecting the technological development of computers were frequently not scientific but social, administrative, even political ones."

The Army's Ballistics Research Laboratory was in a quandary, unable to compute firing tables for new artillery. They needed faster equipment, and this need, says Stern, was "the single most important impetus to technological development in the field of electronic digital computers in the United States."

At the same time, Eckert and Mauchly rose to prominence at the Moore School of Electrical Engineering at the University of Pennsylvania. Mauchly enrolled in a summer course entitled "Engineering, Science, Management War Training" in 1941, and was offered a position on the school's staff. There he met Eckert; the two, along with others associated with the school, eventually built the ENIAC (Electronic Numerical Integrator and Computer), the first computer as we would come to know them.

The book follows Eckert and Mauchly through their many trials and tribulations. While the scientists who worked on the ENIAC pulled together for the war effort, they afterwards fell to bickering and dissension. Eckert and Mauchly wanted to pursue commercial interests, an idea that offended their academic colleagues. They also were involved in several disputes over who had actually invented what, the worst of which was with the eminent mathematician John von Neumann after von Neumann wrote a report on the EDVAC (Electronic Discrete Variable Automatic Computer) without giving Eckert and Mauchly equal billing.

Eckert and Mauchly eventually went on to form their own company. Here they developed the smaller BINAC (Binary Northrop Aircraft Computer), and the UNIVAC (Universal Automatic Computer). Unfortunately, they didn't have much business sense, and consistently underestimated the cost of their projects and the postwar commercial viability of computers. "Eckert and Mauchly were more than optimistic, they were naive," Stern says.

In 1950, the Eckert-Mauchly Computer Corporation, on the brink of financial disaster, sold out to Remington Rand. The first UNIVAC was sold in March of 1951, to the Census Bureau.

This book is filled with interesting and absurd facts. For example, the ENIAC had 17,468 tubes, occupied 1800 square feet and divided in 24,000 microseconds. Its average error-free running time was 5.6 hours. It had no main memory, and programming was done through manual wire panels.



For computer historians, hardware freaks and masochists, the last 66 pages of the book are devoted to von Neumann's "First Draft of a Report on the EDVAC," the computer the Moore School developed immediately after the ENIAC.

Stern's book breathes some life into a subject that could otherwise be stuffy and dull. It shows that computers didn't merely emerge from the primordial swamp of technology full-blown and fired up, but resulted from a series of quirky historical events involving a bunch of quirky people. It makes you wonder what's going on out there right now.

**Eric Maloney**  
Microcomputing staff

## Digital Electronics Troubleshooting

Joseph J. Carr  
Tab Books, Inc.  
Paperback, 352 pp., \$9.95

*Digital Electronics Troubleshooting* is written for technicians, radio amateurs, technical school students and experimenters who have already studied basic electronics but want to understand the principles behind digital electronic circuits in order to troubleshoot and maintain them.

The book's first three chapters provide an overview of digital electronics and a complete explanation of digital numbering systems (binary, octal, decimal and hexadecimal) including specific methods for number conversion between systems. The most common code schemes used in digital circuits to represent binary data are covered in detail, including hexadecimal code, split-octal code, binary-coded decimal, excess-3 code, Gray code, Baudot code, ASCII code and EBCDIC. Various tables and charts illustrate and define the different codes.

Chapter 4 details the different digital logic families—TTL, CMOS, RTL, DTL, ECL, HTL and Schottky TTL. This is followed by separate chapters covering logic gates, arithmetic circuits, flip-flops, counters, display devices, decoders, registers, timers, multivibrators, data multiplexers and data selectors. Throughout this section of the book, specific common TTL and CMOS integrated circuit devices are described (including pin-outs) and several logic-gate experiments are detailed for hands-on experience.

Chapters 14–18 are primarily of interest to those involved with data transmission and computer applications. Parallel, serial and current-loop interfaces are described, with particular emphasis on UART (universal asynchronous receiver-transmitter) chips and telephone line use. Computers and microprocessors are generally discussed, with details of the Zilog Z-80 registers and pin functions. Memory input/output interfacing and data conversion (analog-to-digital and digital-to-analog) with circuits are covered in separate chapters.

Chapter 19 has formulas and circuits for dc power supplies for digital equipment, including overvoltage protection and output current-limiting. Test equipment for electronic equipment is briefly discussed in Chapter 20, with a short description of logic probes and logic analyzers. Chapter 21 finally gets into actual troubleshooting, with descriptions of common problems—power supply, temperature, power line voltage and transients, glitches, passive and active bus termination, ringing and radio-frequency interference. Unfortunately, this chapter is only 15 pages long!

The final chapter covers computer peripheral equipment, and includes brief descriptions of printers, paper tape readers, magnetic storage devices and plot-

ters/recorders.

Appendix A shows two logic-level detector circuits using an LED (light-emitting diode) indicator. Appendix B is the circuit of a four-channel oscilloscope switch, without explanation or pin numbers. A detailed three-page index completes the 352 pages.

This is an excellent book, brimming with useful information presented in a logical manner, but the title is misleading. Except for Chapter 21, there is no specific reference to troubleshooting and even this chapter is very general. Its only value in troubleshooting is to acquaint the reader with digital design and devices so that he understands what an improperly functioning circuit *should* be doing. Reading this book will not teach you troubleshooting, which really takes considerable hands-on experience.

Unfortunately, there are lots of errors and omissions in both the text and the illustrations. It's tough enough for a newcomer to comprehend a subject as complex as digital electronics without having to cope with numerous printing errors.

However, don't let this prevent you from buying this book if you don't already have an extensive digital library. It's a virtual encyclopedia of digital information—even if it isn't really a troubleshooting book—and I'm certainly hanging onto mine.

**Fred Blechman**  
Canoga Park, CA

## Programming the Z8000

Richard Mateosian  
Sybex, 1980  
Paperback, 312 pp., \$15.95

Back in the good old days before micros, when you bought a minicomputer, no matter how small or inexpensive, you got a plastic tray or two full of punched

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paper tapes. These tapes contained editors, assemblers, debuggers and sometimes even operating systems, at no extra charge. All you needed to get your new minicomputer running was a terminal and a paper tape reader. The computer was sold complete with all the software you needed to edit, assemble, load and run your programs. The last mini I purchased included the computer, 4K bytes of core memory and all the software and documentation required. All for \$2000.

Now you can buy one of the new 16-bit micros for about \$100, for the CPU chip alone. If you want to use the chip, you're in trouble since you don't get an assembler with it. Most manufacturers won't even sell you one that runs on your new 16-bit processor. They expect you to spend between \$12,000 and \$25,000 for a development system based on an old 8-bit micro. Then for an additional \$1200 to \$2000 you can purchase an assembler that will run on the 8-bit machine, to generate the object code for your 16-bit micro. This is progress?

All of this is to point out how valuable *Programming the Z8000* can be to anyone dedicated to using this new super-chip. If you have to get a Z8000 going and have a limited budget, you might as well resign yourself to handcoding your own resident assembler. The first tool you will need will be Zilog's Z8000 programming manual. Next you would be well advised to buy Mateosian's book. The combination will have you well on your way to understanding the internals of the Z8000.

*Programming the Z8000* covers a lot of material. It discusses how the bit patterns within the machine-language instructions are arranged. This subject is ignored in Zilog's manual, since they expect you to buy their assembler. The book then gives sample programs for communicating with a terminal, among

many other examples. Each instruction in the programs is discussed, enabling the reader to learn assembly-language programming as well as the Z8000 instruction set. With this book the dedicated experimenter could get a minimal system up and running and learn enough to be able to write a complete assembler himself.

Now for the bad news. This is not the most readable book I've ever seen. Stringing multiple instructions together on one line does not make assembly-language programs readable. The author admits that this is a matter of style, and I admit that more experienced programmers will not find this much of a disadvantage. But a newcomer to the Z8000 would have been better served if the program examples had one instruction per line and used the remaining space for detailed comments.

Since certain parts of the book—like the 57 pages of instruction set descriptions, in particular—will become a heavily referenced set of sheets, the book would have been much more usable if it had been bound so you could open it out flat without destroying the binding.

Of course, it is what is on the pages that is important. Mateosian's breakdown of the instruction set, showing which bits control what functions in the Z8000, is vital to the kind of hackers who will be trying to build up a Z8000 computer from scratch. But this kind of endeavor is for the dedicated, and this book will take some studying. It is not for beginners, nor is it necessary for those fortunates who have access to an exotic development system. But for the rest of us crazies all I can say is that I wouldn't be without it.

You might have trouble identifying this book, however. The cover artist got carried away and the illustration which is supposed to look like Z8000 has been so stylistically rendered that it looks more

like a chrome-plated gear shift lever chasing a bunch of billiard balls.

The title on the edge of the binder is readable, though. If you can find it, buy it.

**Ken Barbier**  
Borrego Springs, CA

## APF Technical Reference Manual

APF Electronics  
Softbound, 80 pp.

While this manual is for the technical person, it includes material that will help both beginning BASIC and assembly-language programmers. Both the MP1000 game computer and the Imagination Machine itself are covered.

Tips are given to BASIC programmers for saving memory space and speeding up program execution. A chapter is devoted to assembly-language programming, as is one to useful routines. Short programs are given to demonstrate various tricks that can be done with the APF.

Low and high resolution graphics are explained much more thoroughly than in the instruction manual supplied with the computer. The APF owner's manual only tells you the BASIC words allowed and a little about each one. This manual is a nice addition.

The book includes block diagrams, system timing, memory maps, MC6800 instruction sets, schematics, parts layout, keyboard matrix, reserved words and ASCII codes.

You'll never experience the full potential of the APF Imagination Machine without this handbook, no matter what level of microcomputing you may find yourself at.

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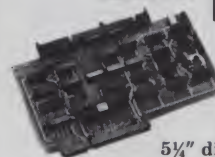
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# PERSPECTIVES

(from page 242.)

There might be regulations regarding how the records are to be kept. For example, a federal regulation might require that quality assurance records from the production of a batch of serum be kept for seven years. Furthermore, it must be readable—this means printed reports (not disk or tape)—and it also must be nonthermal (since some thermal paper fades after a period of years).

10. *How many and what sort of people will be using the system?* Office personnel, salespeople, managers, owners, loading dock people, customers. This will have an impact on the operator interface and its level of user-friendliness.

11. *How long can the system hardware be down before it has a serious effect on the business?* This question will determine the level of hardware reliability of the system. It might be necessary to institute a series of backup measures for a hardware failure. For example, some form of hardware service contract, redundant hardware, short-term rental agreement worked out in advance, a 24-hour-a-day service contract with a specified response time.

You need to determine how expensive down-time is to the client before you choose a backup measure. Keep in mind that there are hardware failures other than a failed component. For example, noisy ac line, power outage, dirty or poor quality media, theft, improper environment for the system (temperature, humidity, static).

12. *How long can the system software be down before it has a serious effect on the business?* Some of the software measures that you can take are software service contract, programmer on call, the quality assurance/testing phase of software development. This list points up a fundamental difference between the hardware and software. It is possible to spend enough money (for the redundant hardware) to ensure that the system will keep running. It is not quite that easy

**"Unless you're telepathic,  
never assume  
you understand what  
your client is saying."**

with software. The first two options might be adequate, but it is my belief that the only way to really provide any assurance of software up-time is to build it in (at design time) and test it in (during the testing phase).

13. *What, if any, manual backup systems do you want to maintain with the computer system?* This has a major impact on the design of the system. It can affect the design of the programs, databases and operating procedures.

14. *How much do you want to spend on the total system?* All the front-end costs, including hardware, software, system integration, training. It is best to get a range that the client can afford and then show the client the trade-offs and what can be upgraded at a later date (if a trade-off was made). (You can suggest a less reliable printer but don't recommend a less reliable disk.)

15. *How much do you want to spend on continuing support?* Retraining, system modification, hardware maintenance, software support and machine rental (a real alternative).

In some ways this questionnaire can be intimidating. It makes the client consider the possibility of hardware and software failures, long switch-over periods, system growth and maintenance. The client might have thought he could buy everything off the shelf (and some salespeople might agree). The questions (and the communication between the client and consultant) may be difficult, but it is unlikely that a good system will be developed without them.

When you are ready to talk with a client, use a two-pass proposal. The first proposal will state that you will do the initial system analysis for a specified fee. The product of this analysis will be a second proposal which will be your complete system proposal.

## The Fee

There are two important questions with regard to the consultant's fee—how much and in what way do I get paid?

The amount is arbitrary. Remember that you are doing the consulting on your own time. Be sure to take into account the cost of travel, equipment and supplies. Also, don't overcharge based on your talents. Take into account if this is your first consulting job or if it is outside of your expertise.

You will need to pay income tax on your consulting income. Check with the current federal, state and local government regulations with regard to self-employment income. It is very important to check immediately, because income that is a major portion of your annual salary is subject to taxes every quarter. If you wait until April 15th, you might have to pay a penalty and interest above and beyond the taxes.

There are several ways that the fee can work. One way is to bid on the whole system and the consultant will provide almost everything. I would not suggest doing this unless you are very experienced in the application and with consulting in general. A better approach for a first-time consultant is to charge an hourly or daily rate. This way, if you miscalculate how long the application will take, it is not disastrous for you.

It is wise for a consultant to set up an agreed-upon method for payment. Some of the possibilities might be: one lump sum at the start of the project; a lump sum at the end of the project; regular monthly payments; partial payment at the completion of project checkpoints. I recommend the partial payment at project checkpoints. This shows the client where his money is going.

## Conclusions

Now you know what consulting is—a professional activity that you can perform. Finding clients can sometimes be difficult, but you have some places to start looking—computer stores and the general business community.

Communication is a fundamental part of the client/consultant relationship. The system requirements questionnaire is a tool to assist you in those communications. As a final suggestion, you should always act in a professional manner—organized, competent, knowledgeable. That is why you were hired. □

# MICRO QUIZ

(from page 12.)

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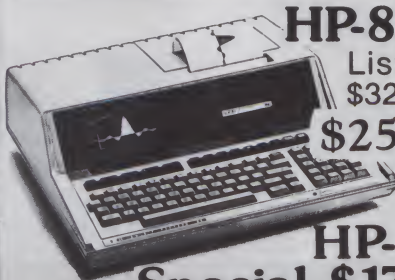


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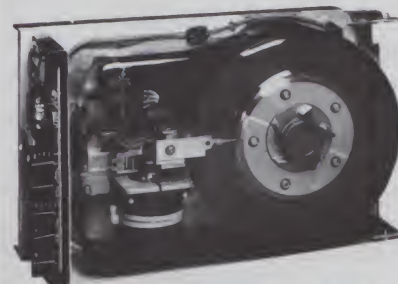
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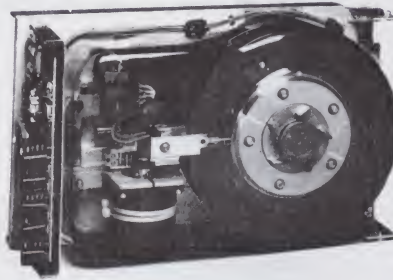
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# So, You Want To Be A Consultant

## Testing The Open Market

Any time that you, as a computer professional, perform technical work outside of your full-time job, you are consulting. Consulting is a wide-ranging term. As it relates to computers, it includes:

- systems analysis
- business programming
- scientific programming
- system configuration
- system recommendations
- system maintenance
- system troubleshooting

Consulting can be a very exciting and profitable activity; however, as we shall see, it is not always easy.

### Where to Find Consulting Work

Computer professionals have skills for which a client is willing to pay. How do you find clients in need of your services? Some fairly simple methods are:

- Run advertisements in local newspapers.
- Make arrangements with retail computer stores to put your name on a list of consultants.
- Contact computer manufacturers. Many times they keep a list of consultants, which allows them to offer complete systems—their hardware and system software and a software consultant to customize the system.
- Check the phone book yellow pages for possible clients.
- Contact the local government agencies (city, county, state and federal), which occasionally make use of consultants.

A word of warning—most of you are employed, full time, for your technical skills. Your company probably has some policy regarding outside employment. In the company's eyes, consulting might be a nice word for conflict of interest. Be sure to check with your supervisor, personnel manager or other appropriate person. Consulting can be lucrative, but it might not seem as attractive when it is your only source of income.

### What to Do with a Client

Clients are a strange and unusual breed; they require very special handling and care. Unless you are telepathic, never assume you understand what your client is saying. The client can say something that makes sense to both of

you, but means two entirely different things. For example, your client says that he has used computers before. You understand him to mean that he has programmed before. He meant that he assembled card decks and fed them into a remote job entry station.

### Questionnaire

I have included a systems requirements questionnaire, intended to direct both the client and consultant towards a well-defined, well-documented description of a proposed computer system. This questionnaire is only a guideline. It does not include every question necessary for all applications. It is for the class of consulting that is most common—business applications. Since it is very open-ended, it can, and sometimes should, take a long time or several iterations to complete.

1. *What do you expect the computer to do?* For example, do you want accounts payable, inventory, a real-time flight simulator, a management information system, process control?

2. *Describe as completely as possible the tasks in question 1.* For inventory applications, an example might be: Database Description—number on hand, lower limit for restock alarm, upper limit for overstock alarm, vendor, color, size, location in warehouse, retail and wholesale prices, links to items that might be a substitute.

Operations on Inventory Database—add an item, delete an item, update an item, examine current status, list restock needs, list overstock items, calculate profit for a sale on an item. Miscellaneous—approximately 400,000 items in inventory; the inventory files are to be on line; only certain people can add, delete or edit an inventory item.

3. *What sort of growth or changes do you expect for the description in question 2?* For example, ZIP codes going from five to nine digits, or adding a new field to inventory items to account for product smell.

4. *List any peculiarities of your business or the jobs you are expecting the computer to perform.* For example, the owner of the company has to have a good implementation of backgammon available on the system. The company

payroll regularly deals with transient workers (they might not have a permanent address or social security number). The inventory has large fluctuations, on a seasonal cycle (or on no cycle). The system needs to be able to handle simultaneous on-line sales, receiving, shipping and management inquiries (this implies some database lockout mechanism to ensure there is always correct data in the database).

5. *From the list in question 1, what is the minimum you will be satisfied with for the first running system?* If the client wants a large system, he should start out small and slowly build up to the maximum system. This limits the amount of work and equipment invested before the client sees the system (in case the client doesn't like some aspect of the system). It will give the employees the opportunity to become familiar with the idea of a computer and the system you are implementing.

6. *Over what period of time will it be acceptable to build up from the minimum system to the total system?*

7. *Is there a good time to get the system up and running?* Does the business have a seasonal lull or holiday hiatus?

8. *What sort of switch-over to the computer do you want to have?* Some options are complete overnight conversion, phased introduction of each portion of the new system and a parallel operation of both systems for an arbitrary period of time.

9. *What long-term information needs to be stored, how long does it need to be kept and in what form must it be stored?* An example for an inventory system might be: Once a month the inventory files are dumped to tape for archival storage (not at the business site). Also, each month the transactions to the inventory are dumped for archival storage (so at least a partial inventory can be regenerated in case the on-line files are destroyed). The monthly files are kept for four months and then recycled. Once a year the inventory is dumped to tape and saved for ten years.

(continued on page 238)

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